

STUDIES IN BLISTER BLIGHT CONTROL

XIII. METHODS OF FUNGICIDAL APPLICATION IN THE CONTROL OF THE BLISTER BLIGHT DISEASE OF TEA

C. A. Loos

Over the last six years many forms of machinery for the application of fungicides have been tested out on Ceylon tea plantations, for the control of the blister blight disease of tea. The machines may be classed in three categories:—

- (1) Large motorised, or motor-borne, units which require motorable roads for transportation. (Todds Insecticidal Fog Applicator, or the Micron Sprayer)
- (2) Motorised units which are too heavy for carriage by an individual, and which require footpaths for transportation. (Mini-Micron Sprayer or the "Whirlwind Duster").
- (3) Units (motorised or hand-operated) which are sufficiently light for carriage by an individual and which can be conveniently carried along tea rows and over steep terrain. (Knapsack sprayer (both pressure-retaining and other types), rotary hand dusters, and the Duiker Mist Blower).

Categories 1 and 2 require fields which are adequately intersected with roads to allow the application of fungicide from different directions under frequently changing wind conditions. Haworth' has shown that copper dusts applied through the "Whirlwind" duster gave excessive copper deposits close to the machine, and inadequate deposits as the distance from the point of application increased. Under controlled wind conditions most of the copper, in the dust, fell in the first 100 feet and, though the dust was seen to carry for a considerable distance, deposits of copper beyond 250 feet were negligible. The Micron sprayer gave results similar to that of the duster, but was even less reliable as the mist became invisible 20 yards from the machine. The use of these types of machines is, therefore, limited, not so much in the method of application, but in the uneven deposits of copper particles over wide areas.

Marked advance has been made in machines listed in category 3. In this category we have three methods of fungicide application which are effective, practical and economic.

Knapsacks. The most desirable type is the pressure-retaining knapsack which is charged with fungicide through either a portable or motorised charge pump. Of the many makes of knapsacks now available all show considerable improvement over those in use six years ago. Further advances in design, construction and anti-corrosion protection are still required to enable the use of machines for spraying of insecticides, lime-wash and caustic washes.

The most spectacular advance has been in nozzle design. With the double swivel nozzle, manufactured by the Sprayings Systems Company of America, fitted with OC-O2 jets, now obtainable through the Colombo Commercial Company Limited, efficient protection is possible and enhanced acreages obtained per sprayer. In the experiment described in this article two rows of tea were sprayed simultaneously, but it seems reasonably possible that four rows could be given effective fungicide cover with correct nozzle setting, and this idea is at present being tested out in the field.

Rotary Hand Dusters. A number of makes have been on test. The most reliable has been the 'Orient' hand rotary duster, distributed by Messrs. Walker Sons & Company, Ltd. A recent development has been a duster manufactured by the Kestrel Engineering Works, though the model is still not available for general distribution.

Duiker Mist-blower, Type MAA—1953. The prototypes of this machine, manufactured by the Duiker Company of Holland, were developed by Mr. van Bommel of the Royal Dutch Shell Laboratory on Kataboola Estate, Kounale and St. Coombs, Talawakelle, in 1952 and early 1953. Machines were available in Ceylon from May 1953.

The machine, including a charge of $1\frac{1}{2}$ gallons spray liquid, weighs approximately 56 lbs. The unit is carried by means of two shoulder straps which sling the motor on to the operator's back while the two $\frac{3}{4}$ gallon spray containers are suspended on to the straps over the chest. The spraying part of the equipment consists of a movable blower fitted on a light weight metal arm and driven by a flexible drive from the engine. In the blower is a nozzle giving a hollow cone spray of an output of 2 imperial gallons per hour at 65 lbs. per square inch. The pressure in the spray tank is derived from the engine cylinder and passed through a non-return valve which prevents the blow back of liquid into the cylinder, should the engine stop during spraying operations. The blower is driven by the engine through a friction gear and clutch, a flexible cable and blower gear. The blower speed is approximately 11,000 r.p.m. The engine is fed with a mixture of petrol and oil and has a consumption of about 1 pint per hour.

The friction gear driving the blower, the non-return valve and flexible drive were the cause of frequent breakdowns during the trials on Meddecoombra Estate. The machines, after these faults were rectified, gave almost trouble-free service on Ragalla Estate.

The Meddecoombra and Ragalla Experiments

Meddecoombra Experiment. This experiment, which commenced on May 1st, 1953, and continued until September 30th, 1953, the duration of the South west monsoon, incorporated three forms of fungicidal application:—

(a) **Knapsack Spraying.** By means of the "Vermorel" pressure-retaining knapsack fitted with American Spraying Systems Company's double swivel nozzle and OC-O2 jets for spraying two rows of tea simultaneously. Shell copper fungicide was applied at a concentration of 4 ounces in 10 gallons water at approximately 15 gallons per acre, at 9-10 day intervals. A battery of 7-8 knapsacks, supported by 2 charge pumps, was in operation. The spraying gangs were supervised by a kangany. Two labourers manipulated the charge pumps, moved them from point to point as required, and mixed the fungicide. Bunded drains, streams and springs were used as the source of water supply. Water was at no time in this experiment transported by tractor or lorry.

(b) **Dusting.** The working gang consisted of a battery of 8 'Orient' rotary hand dusters, supervised by a kangany. An extra labourer helped to move dust and fill the containers. 'Cuposana' 4 per cent copper dust was applied at 5 day intervals at 5 lbs per acre per application. There were, therefore, 2 applications over the plucking round of 10 days, or an application of 10 lbs dust per plucking round. Dusting was done across 5 row bands.

(c) **Mist-blowing.** Four new machines were purchased while a further three prototype models were on loan from the Shell Company. Batteries of 5 mist-blowers were in general use, with 2 machines in reserve. The stand-by prototype machines had to be used frequently due to breakdowns of the standard machines.

Shell copper fungicide at a concentration of 6 ounces to 1 gallon water was applied at 1 gallon per acre. Mist-blowing was done over 5 row bands at 9-10 day intervals. In addition to the 5 operators, 2 labourers carried extra machines, fungicide containers, petrol etc. The spraying gang was supervised by a kangany while

an apprenticed mechanic was in attendance for running repairs, etc. It may be possible, if the standard machines do not have frequent breakdowns, to run a battery of 5 machines with one stand-by. Considerable spraying hours were lost due to change over of machines and the necessity for repairs in the field.

Acreages involved in the experiments were as follows:—

Hand spraying:	All first year fields		185 acres
Dusting:	1st year fields	92	
	2nd year fields	158	
		—	250 acres
Mist-blowing:	1st year fields	181	
	2nd year fields	52	
		—	233 acres

In each field a control (unprotected) plot, about 1/8th of an acre in extent, was marked out for a comparative assessment of the degree of control effected between protection and no-protection, and for an assessment of the severity of blister blight during the season under review.

Effectiveness of protection. Weather conditions were not very favourable to blister blight infection during the first two months of the experiment. May was almost rain-free; June weather was favourable to blister for about 10 days, but during the latter half of the month brilliant weather prevailed; July had 30 rainy days during which blister blight built up in intensity on the unprotected areas. A break in the weather from August 1st to 13th caused a further set-back to blister and it was not until early September that comparable results, with any degree of reliability, were possible. In September the unprotected plots showed a considerable amount of leaf blisters and light die-back of plucking shoots caused by stem infections. The knapsack sprayed areas were almost totally free of infection. Occasional bushes in the dusted areas showed severe infection while the mist-blown areas, though fairly well protected, showed the highest incidence of infection. Occasional complete rows showed numerous blisters indicating that either a change in wind direction or cessation of wind caused an uneven distribution of the fungicide.

Ragalla Estate. This experiment was over 200 acres of tea varying in age from 15 months to 56 months from pruning and protected with the modified Duiker mist-blowers. Shell Copper fungicide was used in this instance too at an application rate of 1 to 1½ gallons per acre, of a mixture of 6 ounces fungicide in 1 gallon water. Protection was very good over a season which had been generally considered very favourable to blister blight.

The Manager of Ragalla Estate comments as follows:—

“At the start the engines gave considerable trouble on wet days and the aggregate loss of working time with five machines amounted to as much as two hours a day. Rain getting into the carburettor was the main cause of trouble, but this was remedied by providing a zinc cover for the carburettor and the air filter. Sparking plugs gave frequent trouble due to carbon deposits accentuated by the necessary addition of oil to the petrol tank. Changing of all plugs in all machines, twice a day, whether trouble was being experienced or not, reduced stoppages very considerably.

A high standard of maintenance is essential for good results and a good mechanic must be in attendance in the field. An intelligent factory worker could doubtless be trained for this work and his wages might be estimated at Rs. 3/50 a day while so employed.

The engine produces considerable vibration and it is, therefore, a harder task for the operator than when he works a knapsack sprayer. The equipment is secured in front and behind the operator and, should he fall, results could be very unpleasant. I do not recommend this equipment on very rough or steep country.”

The cost of equipment and application. Choice of the type of machinery used in fungicide application must depend on a number of factors, chief of which is the availability of labour. Other factors are the severity of attacks of blister blight, the availability of water and supervision. Both spraying and dusting operations require careful organisation of estate practices. Pluckings must be so arranged that a reasonable period elapses between applications of the fungicide and removal of leaf for manufacture, to avoid excessive copper residue in the manufactured tea.

We do not advise the recruitment of extra labour to allow of protection by spraying, unless labour requirements are already below normal estate requirements. Extra labour must only be recruited if, during the four or five months when no spraying is done, work can be found for the extra labourers. If labour shortage has to be reckoned with, the choice of protection methods lies between dusting and mist-blowing. New dust formulations, now available, show marked improvement in formulation and, therefore, enhanced control. The choice is, therefore, obvious as mist-blowing has not given control superior to that of dusting, and more intelligent supervision is essential in working the mist-blower.

The size of spraying or dusting gangs must depend on the frequency of plucking rounds and the acreages plucked each day. A safe practice is to spray or dust the day after plucking, the full acreage plucked the previous day. On estates, where plucking rounds are at 10-14 day intervals, fewer knapsack sprayers would be required than on estates plucking at 5-7 day intervals, as only one application of the fungicide would be required in either case. Where dusting is the method of protection adopted, estates on 10-14 day plucking rounds, would require more dusting units than would be necessary if plucking rounds are at 5-7 day intervals, as two applications of dust would be required during the longer plucking rounds against one on the shorter plucking rounds.

The average number of acres covered by an operator in the Meddecoombra experiment was 3.7 acres with the double nozzled knapsack, 6.6 acres with the mist-blower and 8.0 acres with the duster. Utilising conveniently sized batteries it is, therefore, possible to protect daily 37 acres with knapsack (10 machines), 33 acres with the mist-blowers (5 machines) and 64 acres with the dusters (8 machines). These figures must be considered as minimum acreages as some estates claim as many as 5 acres with a knapsack, 10 acres with a duster, and on Ragalla Estate an average of 9 acres was covered with a mist-blower.

Accurate costings, applicable to all estates, are not possible as factors such as type of terrain, weather conditions and efficiency of labour, all of which effect costs, vary considerably from estate to estate. However, the costings of the Meddecoombra Estate experiment may serve as a useful guide in the preparation of estate annual estimates, and are published on that assumption.

The cost figures from the Meddecoombra Estate experiment are used to estimate the cost of apparatus and application of fungicide over an assumed acreage of 500 acres. In the first set of cost figures plucking rounds are at 10 day intervals and would require two applications of dust for effective protection. In the second set of costing figures plucking is assumed at 8 day rounds.

The costings are based on the following assumptions:—

- (a) Area to be protected—500 acres.
- (b) Protection period—May-December (8 months).
- (c) Spraying with "Vermorel" pressure retaining knapsacks fitted with American boomjet nozzles and OC-O2 tips for spraying two rows of tea simultaneously. Acreage per knapsack at 3.7 acres.
- (d) Dusting with the 'Orient' rotary hand duster. Dusting to be done across 5 row bands. Acreage per duster at 8.0 acres.
- (e) Mist-blowing with the Duiker mist-blower. Applications to be made across 5 row bands. Acreage per mist-blower 6.6 acres.
- (f) Materials and labour at current cost.
- (g) Crop return of 750 lbs. made tea per acre.

Cost Estimations 1A

Knapsack spraying of two rows of tea simultaneously with the "Vermorel" pressure-retaining knapsack fitted with the American double swivel nozzle with two OC-O2 jets. Copper fungicide applied at 15 gallons per acre at 10 day intervals (9 ounces copper per month).

2 batteries (1 of 8 and the other of 9 knapsacks with 2 charge pumps per battery). Spraying for 24 days a month for 8 months.

Cost of Equipment.

(1)	17 Sprayers at Rs. 250/-	Rs. 4,250.00	
(2)	4 charge pumps at Rs. 345/-	1,380.00	
(3)	17 double nozzles at Rs. 21/-	357.00	
		Rs. 5,987.00	
(4)	Depreciation per annum at 25%	Rs. 1,496.75	
(5)	Depreciation per acre per annum		Rs. 2.99

Cost of Fungicides.

(6)	4,500 lbs at Rs. 2/- per pound	Rs. 9,000.00	
(7)	Cost per acre per annum		Rs. 18.00

Cost of Labour.

(8)	17 Labourers for spraying		
(9)	4 labourers for charge pumps.		
(10)	4 labourers for water carriage		
(11)	2 kangaries for supervision		
(12)	27 labourers at Rs. 52/56 per month of 24 days for 8 months	Rs. 11,352.96	
(13)	Cost per acre per annum		Rs. 22.71

Other Items.

(14)	Sugar and tea to sprayers	Rs. 483.84	
(15)	Bonus to sprayers at 25 cents per working day	Rs. 1,296.00	
		Rs. 1,779.84	
(16)	Cost per acre per annum		Rs. 3.56
(17)	Total cost per acre per annum		Rs. 47.26
(18)	Cost per pound of made tea, assuming a crop of 750 lbs made tea per acre per annum		Cts. 6.3

Cost Estimations—1B

Dusting 5 row bands with an 'Orient' rotary hand duster. "Cuprosana" 4 per cent copper dust applied at 5 lbs per acre every 5 days. (19-1/5 ozs. copper per month). Plucking rounds at 10 day intervals. Dusting 24 days a month for 8 months. 2 batteries of 8 dusters required to cover 500 acres.

Cost of Equipment.

(1)	16 'Orient' dusters at Rs. 145/-	Rs. 2,320.00	
(2)	Depreciation per annum at 25%	Rs. 580.00	
(3)	Depreciation per acre per annum		Rs. 1.16

Cost of Fungicide.

(4)	120,000 lbs at Rs. 39.90 per cwt.	Rs. 42,750.00	
(5)	Cost per acre per annum		Rs. 85.50

Cost of Labour.

(6)	16 labourers for dusters		
(7)	2 labourers for carriage of dust		
(8)	2 kanganies for supervision		
(9)	20 labourers at Rs. 52/56 per month of 24 days for 8 months	Rs. 8,409.60	
(10)	Cost per acre per annum		Rs. 16.82

Other Items.

(11)	Sugar and tea to dusters	Rs. 358.40	
(12)	Bonus at 25 cents per working day	Rs. 960.00	
		<hr/>	
		Rs. 1,318.40	
(13)	Cost per acre per annum		Rs. 2.64
(14)	Total cost per acre per annum		Rs. 106.12
(15)	Cost per pound made tea, assuming a crop of 750 lbs per acre per annum		Cts. 14.15

Cost Estimations—1C

Mistblowing 5 row bands with the Duiker mist-blower. Copper fungicide at a concentration of 6 ounces in 1 gallon water applied at 1 gallon per acre at 10 day intervals (9 ounces copper per month). Spraying 24 days a month for 8 months.

Cost of Equipment.

(1)	10 mist-blowers at Rs. 1,625/-	Rs. 16,250.00	
(2)	Depreciation at 33½ %	Rs. 5,416.66	
(3)	Depreciation per acre per annum		Rs. 10.83

Cost of Fungicide.

(4)	4,500 lbs at Rs. 2/- per pound	Rs. 9,000.00	
(5)	Cost per acre per annum		Rs. 18.00

Cost of Labour.

(6)	10 labourers for mist-blowers.		
(7)	2 labourers for water carriage		
(8)	2 kanganies for supervision		
(9)	14 labourers at Rs. 52/56 per month of 24 days for 8 months	Rs. 5,886.72	
(10)	Cost per acre per annum		Rs. 11.77
(11)	2 mechanics (at special pay rate of Rs. 3/50 per working day Rs. 84/- per month)	Rs. 1,344.00	
(12)	Cost per acre per annum		Rs. 2.69

Working Costs.

(13)	Petrol at ½ pint per acre per applica- tion = 750 gallons at Rs. 2/60	Rs. 1,950.00	
(14)	Oil at 4 per cent of petrol used = 30 gallons at Rs. 9/09	Rs. 272.70	
		<hr/>	
		Rs. 2,222.70	
(15)	Cost per acre per annum		Rs. 4.44

Other Items.

(16)	Sugar and tea to sprayers	Rs.	250.88	
(17)	Bonus to sprayers	Rs.	672.00	
		Rs.	<u>922.88</u>	
(18)	Cost per acre per annum	Rs.		1.84
(19)	Total cost per acre per annum	Rs.		49.57
(20)	Cost per pound of made tea assuming Crop of 750 lbs per acre per annum			Cts. 6.61

Cost Estimations—2A

Spraying 2 rows simultaneously with "Vermorel" pressure-retaining knapsack fitted with American double nozzle with two OC-O2 jets. Copper fungicide applied at a concentration of 4 ounces in 10 gallons water and applied at 15 gallons per acre every 8 days. (11½ ounces copper per month). Spraying 26 days a month for 8 months.

Cost of Equipment.

(1)	20 sprayers at Rs. 250/-	Rs.	5,000.00	
(2)	4 charge pumps at Rs. 345/-	Rs.	1,380.00	
(3)	20 double nozzles at Rs. 21/-	Rs.	420.00	
		Rs.	<u>6,800.00</u>	
(4)	Depreciation at 25%	Rs.	1,700.00	
(5)	Depreciation per acre per annum			Rs. 3.40

Cost of Fungicides

(6)	5,625 lbs at Rs. 2/- per lb. for 500 acres for 8 months	Rs.	11,250.00	
(7)	Cost per acre per annum			Rs. 22.50

Cost of Labour.

(8)	20 labourers for sprayers			
(9)	4 labourers for charge pumps			
(10)	4 labourers for water carriage			
(11)	2 kanganies for supervision			
(12)	30 labourers at Rs. 56/94 per month of 26 days for 8 months	Rs.	13,665.60	
(13)	Cost of labour per acre per annum			Rs. 27.33

Other Items

(14)	Sugar and tea to sprayers	Rs.	537.60	
(15)	Bonus to sprayers	Rs.	1,560.00	
		Rs.	<u>2,097.60</u>	
(16)	Cost per acre per annum			Rs. 4.20
(17)	Total cost per acre per annum	Rs.		57.43
(18)	Cost per lb. made tea assuming crop of 750 lbs per acre per annum			Cts. 7.66

Cost Estimations—2B

Dusting 4 row bands with an "Orient" rotary hand duster. Copper fungicidal dust of 4 per cent copper, applied at 5 lbs per acre every 8 days (12 ounces copper per month). Dusting 26 days a month for 8 months.

Cost of Equipment.

(1) 9 'Orient' dusters at Rs. 145/-	Rs. 1,305.00	
(2) Depreciation per annum at 25%	Rs. 326.25	
(3) Depreciation per acre per annum		Rs. 0.65

Cost of Fungicides.

(4) 75,000 lbs at Rs. 39.30 per cwt. for 500 acres for 8 months	Rs. 26,316.96*	
(5) Cost per acre per annum		Rs. 52.63*

Cost of Labour.

(6) 9 labourers for dusters 2 labourers for carriage 1 kangany for supervision 12 labourers at Rs. 56/94 per month of 26 days for 8 months	Rs. 5,466.24	
(7) Cost of labour per acre per annum		Rs. 10.93

Other Items

(8) Sugar and tea for dusters	Rs. 215.04	
(9) Bonus to dusters	Rs. 624.00	
	Rs. 839.04	
(10) Cost per acre per annum		Rs. 1.68
(11) Total cost per acre per annum		Rs. 65.89
(12) Cost per pound of made tea, assuming a crop of 750 lbs per acre per annum		Cts. 8.78

*Based on the use of the cheapest suitable dust. The figure will depend on the choice of fungicide and could rise to Rs. 31,640.62, or 63.28 cents per acre per annum.

Cost Estimations—2C

Mist-blowing 5 row bands with the Duiker mist-blower. Copper fungicide at a concentration of 6 ounces in 1 gallon water applied at 1 gallon per acre every 8 days) 11½ ounces copper per acre). Spraying 26 days a month for 8 months.

Cost of Equipment.

(1) 11 mist-blowers at Rs. 1625/- (This is set out at the use of 2 batteries of 5 and 6 blowers to cover 500 acres every plucking round).	Rs. 17,875.00	
(2) Depreciation at 33-1/3% (Suggested depreciation by the manufacturer's Engineer)	Rs. 5,958.33	
(3) Depreciation per acre per annum		Rs. 11.92

Cost of Fungicides

(4) 5625 lbs at Rs. 2/- per pound for 500 acres for 8 months	Rs. 11,250.00	
(5) Cost per acre per annum		Rs. 22.50

Cost of labour.

(6) 11 labourers for mist-blowers 2 labourers for water carriage		
---	--	--