

A REPORT
ON
BLISTER BLIGHT DISEASE
IN CEYLON TEA PLANTATIONS.

- I. THE HISTORY OF THE DISEASE.
 - II. A REVIEW OF ITS EFFECT ON THE TEA INDUSTRY.
 - III. THE WORK OF THE TEA RESEARCH INSTITUTE.
 - IV. RECOMMENDATIONS FOR FUTURE RESEARCH WORK ON METHODS FOR CONTROLLING BLISTER BLIGHT.
-

(Submitted to the Tea Controller on 28th November, 1949, in connection with the provision of special funds for Blister Blight control work).

L

THE HISTORY OF THE DISEASE.

The first record of the disease came from Assam in 1868 when Peal described the manifestations and stated that the disease had been present in that district for some ten years.

Thirty years later, specimens of tea leaves attacked by Blister Blight were sent by Watt and Mann, two Scientific Advisory Officers working for the Indian Tea Association in Assam, to Massee, the renowned Mycologist at Kew, who identified the causative fungus as *Exobasidium vexans*.

The first severe epidemic of the disease was reported from Assam in 1895 and 1900. In 1908 the disease spread to the Darjeeling district where the situation caused grave concern about the future prospects of the tea plantations in that area.

Comparatively little attention was attracted to the disease after the Darjeeling epidemic abated, until it appeared in South India in 1946. It is of interest to record that *Exobasidium vexans* was reported from Formosa in 1912, that it was noticed on tea bushes in the Botanic Gardens of Paiva in Italy in 1925 and again reported in Indo-China in 1930.

The present epidemic, which is causing alarm in all tea producing countries of the world, started in South India in September, 1946. The disease swept like wild fire throughout South India and the spores of the fungus, which are liberated in countless millions, were doubtless carried by the prevailing winds to Ceylon. Thus Dolosbage was the first Ceylon tea growing district known to be infected. The first specimen of tea leaves attacked by Blister Blight were received at the Tea Research Institute in October 1946. The disease spread across the tea growing districts of Ceylon from West to East and the rapidity of its spread

is shewn by the following time table abstracted from the records of the Tea Research Institute which were compiled as diseased specimens came in by every post:—

Dolosbage	...	Oct., 1946.
Pussellawa	...	7th Nov. 1946.
Matale	...	12th "
Madulkelle	...	14th "
Ramboda	...	15th "
Dimbula	...	18th "
Dickoya	...	20th "
Kotmale	...	26th "
Rangalla	...	4th Dec., 1946.
Gampola	...	4th "
Maskeliya	...	4th "
Dehiowita	...	18th "
Hewaheta	...	21st "
Haputale	...	6th Jan., 1947.
Badulla	...	8th "

By the end of January, 1947, the disease had to all intents and purposes, spread over all the tea areas in Ceylon.

Blister Blight continues its advance and was reported from Sumatra in April 1949, where again it spread like wild fire over the 25,000 acres of tea in that Island. It seems almost inevitable that the disease will spread to Java and Malaya.

Strict plant quarantine measures may prevent the spread of the disease to East Africa and place East African growers at an even greater advantage in future competition.

Little is to be gained by enquiring into the cause of the sudden spread of the disease but for the sake of completeness, it may be said that there is one theory which fits all the known facts and is that the barrier of distance and climate between North and South India was breached by transport of the disease on clonal material. Once the disease became established in South India movement of spores in cloud formation is compatible with our present knowledge.

There is some evidence that attacks by the fungus *Exobasidium vexans* may vary in virulence according to strains or types. The possibility of a particularly virulent strain having become predominant is causing some anxiety in Assam according to Mr. C. J. Harrison of the Indian Tea Association Research Station at Tocklai. Speaking at the symposium on Blister-Blight Control held at the Grand Hotel Nuwara Eliya in Ceylon on 10th November, 1949. Mr. Harrison said that the disease had recently become more troublesome in the Assam Valley where climatic conditions have checked the disease previously.

Other theories of the cause of the present epidemic involving aircraft, clothing of travellers, etc. do not fit the known facts and must be rejected.

II.

A REVIEW OF ITS EFFECT ON THE TEA INDUSTRY IN CEYLON.

Blister Blight is undoubtedly the most serious disease which has ever threatened the Tea Industry in Ceylon. Mr. G. K. Newton, in putting the Agency House views before our symposium at Nuwara Eliya on the 10th November last, gave the following estimate of the losses that are being incurred as a direct consequence of the disease:—

"For what is known as the Mid-Country Zone (2,000 to 3,999 feet) the intensity of attacks seems to vary very greatly according to the situation of the fields, but there is a general feeling that crop losses in these areas have now become serious amounting to between 5 per cent and 10 per cent. For the Up-Country Zone (4,000 feet to our highest tea a little over 6,000 feet) the losses appear to be even greater, in this case estimated at between 5 per cent and 20 per cent, according to the situation of the fields."

On the basis of Mr. Newton's estimates, it would seem that an overall loss of some 10 per cent must be accepted as the probable minimum for the whole of the Mid and Up-country tea areas. These areas combined produce more than half of Ceylon's total crop so that it is not unreasonable to assume that Blister-Blight alone is responsible for a loss of rather more than 5 per cent of our total tea production. As the Customs returns for tea exported in 1948 were 296,000,174 lb. a 5 per cent loss of crop represents almost 15,000,000 lb. for this year alone. Furthermore, as most of this tea would have been High Grown it would have been expected to sell at well over the average price.

The Colombo Brokers' Association Weekly Tea Market Report No. 137 for the week commencing 14th November, 1949, quotes the following average prices as having been obtained:—

High Grown Teas ...	Rs. 3.16 per lb.
Medium Grown Teas 2.72 per lb.

On the assumption that these price levels will be maintained and putting the average value of the tea lost through Blister Blight at a round figure of Rs. 3.00 per lb. it would appear that Blister Blight is at present causing a loss to the national economy of the order of some Rs. 45,000,000 per annum. Even calculated on the basis of the 1949 contract price the loss amounts to approximately Rs. 27,000,000.

Figures supplied by the Tea Controller give the acreages under tea in the various elevation categories to be as under:—

	Acres.	Acres.
High Grown ...	121,000	
Medium Grown ...	221,000	
		<hr/> 342,000
Low Grown ...	138,000	
Unclassified ...	63,000	
		<hr/> 201,000

On the above basis it will be seen that the High and Medium Grown teas constitute a good deal more than half of the total acreage under tea. In spite of this, however, the above estimate that approximately half the total crop is affected by Blister Blight should be allowed to stand since —

- (a) The levels of yields are generally somewhat higher in the Low-Country.
- (b) Infection is rather less in those areas such as the Uva District, which only have heavy rainfall during the North East Monsoon period.

In addition to the general Agency House views presented by Mr. Newton, individual Agency Houses have been approached by us and asked to furnish confidential information as to how Blister Blight is affecting their various properties. Although returns are still very incomplete, we have had replies to-date from some 12 Agencies giving particulars of some 38 different estates which are seriously affected by Blister Blight. A portion of one of these replies may be quoted as illustrating the type of attack now being experienced:—

“Blister has been bad throughout the estate this year but in particular in No. 1 field situated on a plateau at about 4,800 feet. This field was pruned between the 1st and 19th November, 1948, and was attacked on recovery in January. The field never really came into full plucking before the monsoon broke again, when it again contracted Blister Blight so badly that it had to be thrown out of plucking. It is still in a very bad condition and has shed nearly all its leaf. Below is a record of its yield per acre month by month since last pruning:

January	...	7 lb.
February	...	18 "
March	...	8 "
April	...	53 "
May	...	50 "
June	...	30 "
July	...	2 "
August	...	—
September	...	—

(Total to-date ... 168 lb.)

It was formerly a very high yielding field. Yield for the year 1946 July to 1947 June was 821 lb. and 1947 July to 1948 June was 656 lb.

No. 2 field situated on the same plateau pruned in November 1947 has also been badly attacked and is at present out of plucking. Its average monthly yield per acre since last pruning is 27 lb. per acre per month.

Another field, No. 12, situated at about 3,500 feet and having a stream running through part of the field, has also been badly affected ever since last pruning (28th October to 12th November, 1948.)”

This section will not be complete without one further quotation from Mr. Newton's memorandum as follows:—

“Although it is generally admitted that losses of crop are taking place, the Customs returns of the tea exported for the past five years are as follows:—

1944	...	273,453,804 lb.
1945	...	230,042,976 lb.
1946	...	290,511,908 lb.
1947	...	287,259,020 lb.
1948	...	296,000,174 lb.

which figures appear to contradict the general assumption, but I think to some extent the high total output since Blister Blight arrived has been occasioned by increased manuring on Low-Country estates following the greater

availability of artificial fertilisers after the war, and resultant high yields from those properties not affected by the Blight; a higher intensity of plucking on properties which have recently changed hands, and also increased yields from the Uva Province, where weather conditions have been conducive of good flushes and where mature applications have also been increased."

III.

THE WORK OF THE TEA RESEARCH INSTITUTE.

Counter measures to plant or any disease develop in three stages:—

- Stage 1. The investigation of the exact nature and course of the disease.
- Stage 2. Reconnaissance of all possible protective measures based on the knowledge gained in Stage 1.
- Stage 3. The trial of selected protective measures with adequate provision for testing efficiency and cost.

STAGE I

The first stage of the research on counter measures has been completed by the Tea Research Institute. The information about *Exobasidium vexans* published before 1946 proved unreliable and a comprehensive mycological investigation more detailed than anything hitherto attempted was started late in 1946 and completed early in 1949.

This work is accepted as scientific work of the highest standard and is published in the "Transactions of the British Mycological Society."

Gadd, C. H. & Loos, C. A. The basidiospores of *Exobasidium vexans*. Transactions of the British Mycological Society, Vol. 31, pts. 3 and 4, pp. 229-233, 1948.

Gadd, C. H. & Loos, C. A. Further observations on the spore growth of *Exobasidium vexans*. Transactions of the British Mycological Society. (In press).

The main conclusions may be summarised as follows:—

1. The disease is transmitted by spores. These spores are destroyed by a few minutes exposure to direct sunlight but can live for a week in an atmosphere at 90 per cent relative humidity. Spores are about the same size as the particles which are visible in sunbeams.

2. The spores alight mainly on the upper surface of leaves. Infection of under-surfaces is relatively small, which simplifies spraying problems.

3. Under special conditions of humidity and free moisture, e.g. Dew, the spores germinate in 6 to 24 hours. On germination a mucilage is exuded which anchors the spore to the leaf and enables it to force a germ tube through the cuticle into the leaf tissue.

UP TO THIS STAGE THE DISEASE CAN BE CONTROLLED BY SPRAYING

4. The germ tube is only able to penetrate leaves or stems up to 30 days old. Very occasionally it gains entry to an older leaf.

5. After the entry of the germ tube the fungus grows rapidly and causes translucent, i.e. semi-transparent, spots to appear in the leaf in 6-10 days. The fungus flowers and seeds, i.e. sporulates, in 18-21 days. The blister may therefore appear on leaves which are 30 plus 18 days old and gives the false

impression that old leaves are being attacked. The spores are ejected with considerable force and are wind-borne.

AFTER THE GERM TUBE HAS GAINED ENTRY INTO A LEAF OR A STEM (or buds) SPRAYING IS INEFFECTIVE

Systemic fungicides may later be found which are effective at this stage. The selection of resistant strains of tea must also be mentioned as a major method of control.

6. There is **NO RESTING STAGE OF THE SPORE** which enables it to survive for long periods under adverse conditions. There is **NO ALTERNATIVE HOST** (at present) which will harbour the disease.

Drought and sunshine, therefore, give a large measure of control, and after a long drought it takes a considerable time for the level of infection to build up. The disease carries over through drought periods on new growth inside bushes or in damp shady situations.

7. The fungus is highly susceptible to copper-based fungicides but these leave a residue which rules out their use on tea in bearing. The search for fungicides which do not leave objectionable residues (or cause taints) is being actively pursued.

STAGE II

Small scale field experiments to test possible approaches have already made considerable progress. Thus it has been possible to adapt modern low volume spraying techniques to our needs and to cover an acre of tea with as little as ten gallons of spray fluid. Former spraying technique used as much as sixty gallons of fluid per acre.

However, many other crops have to be sprayed as a routine measure against pests and diseases and there is a large fund of

information on this subject available in Europe and America.

In order to draw on this fund of knowledge, Mr. J. Lamb, Deputy Director of the Tea Research Institute, flew to the United Kingdom in August 1949. As a result of this visit, Mr. F. W. J. Lane of Messrs. Plant Protection, Ltd., who has extensive experience derived from the International Colorado Beetle Campaign in Europe, and Dr. R. M. Greenslade who has many years experience of crop protection, including the last five years spent with Messrs. Pest Control Ltd. (who undertake crop protection work on a contract basis) flew out to Ceylon in October.

Advantage was taken of their presence in Ceylon to convene a Conference of Scientific officers from all tea producing countries affected by the present epidemic of Blister Blight and at the Symposium on Blister Blight control held in Nuwara Eliya on 10th November there were present:—

The Scientific Staff of the Tea Research Institute of Ceylon.

Dr. R. M. Greenslade of Pest Control Ltd.

Mr. F. W. J. Lane of Plant Protection Ltd.

Two Officers from the United Planters' Association of Southern India.

One Officer from North India — Indian Tea Association Research Station at Tocklai, Assam.

One Officer from the West Java Experimental Station, Buitenzorg.

One Officer from the Institute of Plant Diseases and Pests, Buitenzorg.

A Dr. Dike also flew from Holland to attend the Conference.

Dr. T. Swarbrick for many years on the Staff of the Long Ashton Research Station

and now Director of Agricultural Development work carried out by the Shell Company flew out immediately after the symposium.

Mr. Lane, Dr. Greenslade and Dr. Swarbrick all represent commercial interests, but crop protection is an economic problem and development and application of crop protection methods must largely depend on commercial enterprise. The final test of any crop protection method is the benefit accruing from its employment and this has to be determined in the field.

Stage 2 may now be regarded as almost complete. Mr. Lane and Dr. Greenslade have not submitted their final reports, but the substance of their recommendations has emerged from a series of Conferences, in some of which Dr. Swarbrick was able to participate. Although these three gentlemen may be regarded as commercial rivals there is complete agreement amongst them on the major issues. Their views may be summarised as follows:—

1. That, results of the experiments carried out by the Tea Research Institute indicate that Blister Blight would normally be easily controlled by spraying methods, thinking in terms of other crops with which they have extensive experience.
2. That, at least for tea recovering from pruning, at which stage the bush is most susceptible to attack by the fungus, there are highly effective protective fungicides already available. Control has been demonstrated by the Tea Research Institute with as little as 4 oz. of "Perenox" per acre costing only 55 cents. It is generally agreed that proprietary fungicides should be tested against this standard.

3. That, the problem of application of the fungicides to the bushes constitutes the most difficult problem the advisory experts have been faced with.

The difficulties of terrain could be overcome by the use of aircraft especially helicopters but this approach is ruled out by the high elevation above sea level at which tea is grown. Many estates are above the ceiling of such aircraft. Fixed wing aircraft could be used but the absence of landing grounds, monsoonal conditions including high wind and mist and the presence of high shade trees rule out approach from the air.

Large power driven machines are ruled out unless extensive road systems are built.

Knapsack spraying is possible provided that labourers can be trained to the work conscientiously and that supply systems can be organised to save time in re-filling.

Small motor driven spraying machines may also be modified to meet the needs of some tea areas. Generally speaking, the problem is mainly a mechanical one and consists of adapting existing machinery to our special needs and developing new types of machines to reduce labour costs.

4. That, large scale experiments should be carried out as soon as possible to gain experience of difficulties, and also to check the successful results achieved in small scale experiments.

IV.
**RECOMMENDATIONS FOR FUTURE
 RESEARCH WORK ON METHODS OF
 CONTROLLING BLISTER BLIGHT.**

In the preceding section two main requirements emerged.

1. Provision of facilities for mechanical work in connection with development of spraying and dusting machines.
2. Provision for large scale field experiments.

The Tea Research Institute is now faced with a problem which has confronted most other agricultural research institutes having to carry out research work on crop protection methods. The Tea Industry of Ceylon has been exceedingly fortunate in enjoying almost complete freedom from major pests and diseases until Blister Blight arrived. Tea Tortrix, which threatened trouble at one period, was fortunately eliminated by a parasite bred and liberated from the Tea Research Institute. The Agricultural and Horticultural Research Stations at Rothamsted, East Malling and Long Ashton have met their requirements under such circumstances by establishment of Crop Protection Sections.

I, therefore, recommend the establishment of a Crop Protection Section of the Tea Research Institute with facilities and staff sufficient to deal with the research tasks set out above. In the first case we must budget for a four-year period after which the whole matter should be reconsidered. The Engineering part of the section could, with advantage, be absorbed by the Factory Experiments and Estate sections of the Institute. It is hoped that large scale crop protection experiments will not be necessary for a period longer than 4 years.

There are two methods of estimating for the expenditure involved.

1. Calculations based on the cost of running existing departments. The Agricultural and Plant Physiological Sections have for a number of years had considerable areas under field experiments. The Factory Experiment Section has been involved in much mechanical work. The average should, therefore, give a very fair estimate.

**AVERAGE COST OF RUNNING ONE
 DEPARTMENT.**

Summary compiled from Current Estimates

	Total for 5 Depart- ments. Rs.	Average per Depart- ment. Rs.
Head of Department (Senior Staff) ...	90,760	18,152
Junior Scientific Staff	74,021	14,804
Sub : Scientific Staff ...	8,570	1,714
Laboratory Equipment	10,000	2,000
Dearness Allowance ...	50,032	10,006
Provident Fund ...	24,205	4,841
Field and Factory Experiments ...	17,500	3,500
Small Holdings ...	37,000	7,400
	312,088	62,417
General Administration and Upkeep ...	216,815	43,363
Depreciation ...	20,000	4,000
Low-Country Sub-Station	10,000	2,000
Capital ...	180,000	36,000
	Rs. 738,903	147,780

On this basis, therefore, the average cost of running a Crop Protection Section for a period of 4 years should approximate to Rs. 150,000 per annum.

The first year will involve heavy expenditure and a factual estimate must therefore be made to cover it.

2. Estimates based on anticipated cost of work to be planned for the first year. These have been very difficult to frame and have delayed the presentation of this report.

1. ENGINEER AND WORKSHOP.

REVENUE ACCOUNT.

Staff.

(a) *Engineer.*

Salary at Rs. 1,250 per month	Rs. 15,000	
House Rent at 10 per cent of salary	• „ 1,500	
Study Tour of Crop Protection Stations	„ 1,500	
Dearness Allowance	„ 5,481	
Passages (2½ @ Rs. 1,065)	Rs. 2,663	Rs. 26,144

(b) *Plant Protection Officer.*

Possibly Mr. F. W. J. Lane on hired service from Plant Protection Ltd. for six months including passages		Rs. 13,333
--	--	------------

(c) *Other Staff.*

Fitter, Turner and Welder @ Rs. 100 per mensem each	Rs. 3,600	
Dearness Allowance (994/- x 3)	„ 2,982	„ 6,582

CAPITAL ACCOUNT.

Workshop	Rs. 8,000	
Equipment and Fittings :—		
Lathe with attachments	„ 5,000	
Vertical Drill	„ 1,500	
Grinder	„ 900	
Welding Plant	„ 1,000	
Machine and Hand Tools	„ 2,500	
Bench and Vices	„ 600	Rs. 19,500
Quarters for minor staff (3)	„ 17,500	„ 37,000
		Rs. 83,059
	Total, Say	Rs. 83,000

2. FIELD EXPERIMENTS.

(a) *Running Costs.*

The primary purpose of these experiments will be to test the *effectiveness* of large scale protection measures.

The experiments will be laid out on a statistical plan and the actual cost of spraying will be secondary. The Engineer will be responsible for development work super-

imposed on this experiment and designed to reduce the cost of operation to a minimum.

One experiment will be carried out in the South West Monsoon period to examine the possibility of restoring the pre-Blisters Blight distribution of labour and crop.

Another experiment will be carried out in the North East Monsoon with the object of supplementing the present system of pruning into dry weather, thus lengthening the period available for pruning. At the present moment pruning is concentrated into a very short period which makes labour distribution exceedingly difficult and costly.

COST OF EACH EXPERIMENT.

200 ACRE SPRAYING EXPERIMENT.

(Based on needs of an *average* estate).

ESTIMATED COST OF LABOUR.

On the assumption that protection is necessary for approximately three months from pruning, this means that a total of some 12 weekly sprayings will be required over the whole 200 acres. To accomplish this a daily labour force made up as follows is considered the minimum possible:—

- (1) 6 Spraying gangs of 8 labourers each. Total 48 labourers.
- (2) 6 Supervisors, one to each spray gang.
- (3) 1 Conductor in general charge of operations.

Completion of the above programme will entail a total of 72 working days per man. On this basis, therefore, labour costs for this experiment are estimated as follows:—

(1) Labourers.		
3,456 days at Rs. 1.90	Rs.	6,566.00
(2) Supervisors.		
342 days at Rs. 2.25	..	972.00
(3) Conductor.		
3 months at Rs. 150 per mensem	..	450.00
	Rs.	<u>7,988.40</u>

Total cost of both experiments, say, Rs. 16,000

(b) Capital Costs.

200 ACRE SPRAYING EXPERIMENT. ESTIMATED CAPITAL COST OF EXTRA EQUIPMENT.

40 Pneumatic Knapsack Sprayers		
@ Rs. 120 each	Rs.	4,800
2 Four Oak Central Charge pumps		
@ Rs. 540 each	..	1,080
2 Gardner Charge Pumps		
@ Rs. 600 each	..	1,200
1 40 Gallon tank	..	100
	Rs.	<u>7,180</u>

Provision for manufacture of new spray booms, nozzles, etc.		
say 33 $\frac{1}{3}$ % of above figure	Rs.	2,393.33
	..	<u>9,573.33</u>

Total say Rs. 10,000.00

3. SUSPENSE ACCOUNT

The Board of the Tea Research Institute authorised immediate expenditure from July 1949 on the assumption that it could be recovered later, when special funds are available. At the present moment this suspense account stands at Rs. 14,049.72,

Say ... Rs. 14,000

The activities outlined above will require, therefore, approximately Rs. 122,000 leaving a balance from the estimated average of approximately Rs. 27,000, which is barely sufficient if experiments are carried out with, say, Orchard spraying systems (involving piped supplies of spray fluids), or with power driven "mist blowers."

It may prove possible to induce makers to loan equipment for trial but as most of it has to be modified, makers may be reluct-

ant to allow us to alter loaned machines. I, therefore, suggest that an average of Rs. 150,000 per annum should be made available for four years and that allowance should be made for a higher average expenditure (up to Rs. 200,000) in the first year.

1st year	...	Rs 200,000
2nd	..	150,000
3rd	..	125,000
4th	..	125,000
Average per annum		Rs. <u>150,000</u>

CONCLUSION.

Dr. T. Swarbrick in addressing the Uva Planters' Association said that 50 per cent of the cost of production of apples in England was accounted for by crop protection items, such as spraying and winter washing. He stressed the point that compared to other crops tea had been fortunate but that Blister Blight is here to stay. Dr. Swarbrick concluded by saying "You will have to learn to live with Blister Blight."

The Tea Research Institute has stressed the same view but not in such apt words. We have, apart from the proposals outlined above, other field experiments designed to modify our agriculture to suit our changed circumstances.

The funds we seek are small compared to the total value of the industry and even to possible loss incurred during the past year. Apart from experiments we must intensify propaganda through lectures and cinematograph shows, to help the planter to re-orientate his ideas and to adapt his management to altered circumstances. We have already been able to borrow four films from Messrs. Plant Protection Ltd. and Pest Control Ltd. shewing the difficulties which have to be faced by growers of other crops. Some part of this special grant for Blister

Blight control work could, with great advantage, be spent on the purchase of a cinematograph apparatus and in obtaining suitable films from firms such as Messrs. Plant Protection Ltd., Pest Control Ltd. and the Shell Company. The Ministry of Agriculture in England and the United States Department of Agriculture also have lending libraries of Agricultural films.

Finally, I must acknowledge the assistance rendered by Mr. G. B. Portsmouth, Plant Physiologist; Mr. C. A. Loos, Acting Pathologist; and Mr. F. W. J. Lane, our adviser from Plant Protection Ltd., as well as the Clerical Staff of the Institute. in compiling this report.

(Sgd.) J. LAMB,

Acting Director,
Tea Research Institute of Ceylon.

Tea Research Institute of Ceylon,
St. Coombs,
Talawakelle.
27th November, 1949.