

# BLISTER BLIGHT

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Blister Blight is the appropriate name given to a leaf disease caused by the fungus *Exobasidium vexans*, which is a recent and unwelcome arrival in Ceylon and South India. This particular disease of tea has been known in North India for nearly ninety years. It is necessary, therefore, to preface my remarks today with the clear warning that we must be very cautious in the use of the Indian reports. Neither you, nor I, can define with real exactitude the similarities and dissimilarities in climatic and other conditions between the two countries in so far as they affect the growth of a particular fungus. It is important, therefore, that we should study the behaviour of the disease in Ceylon, rather than reports of its behaviour in other countries under possibly very different circumstances. A natural corollary is that the present paper, delivered

four months after the first report of the disease in Ceylon, should not be regarded as final.

Reports of the occurrence of blister Blight in Ceylon before 1945 must, I think, be discounted. The first occasion on which the disease was identified was at the end of October 1946, at an elevation of 2,500 feet in Dolosbage. In the ensuing three weeks reports came in from five other Western planting districts, mainly at higher elevations. Subsequently additional centres were reported from each affected district. The "incubation period" of the disease is long enough for it to be likely that the early isolated outbreaks were distinct from, and not a result of, the reported outbreak at Dolosbage. In discussing the subsequent course of the disease I prefer to use the word "occurrence"

rather than "spread." It should be noted that we have no evidence whatever as to the real source of the spores originating the subsequent outbreaks.

New outbreaks occurred more and more frequently from November 1946 until the beginning of January 1947, when a decline set in. The elevational range increased, until it was known above 6,500 feet, and below 500 feet. The greatest number of reports have come from elevations of about 4,000 feet, but it must be remembered that the greatest number of large estates occur at this elevation. If the planting districts as set out in Ferguson's Ceylon Directory are considered, only four districts (Dumbura, Galle, Matara and Weligama, Moneragala) (20th February) have not reported the disease. It is noteworthy that it appeared in Uva during the prevalence of north-easterly winds.

The economic effects of the arrival of the disease are difficult to assess. Every new disease is a threat to the industry. But there are, fortunately, only a few estates that claim to have lost much crop additional to the loss that would have resulted, in any case, from the adverse climatic conditions at the time. In this we can reckon ourselves fortunate, for there can be no question that the disease can inflict very serious damage if severe attacks recur in fields recovering from pruning.

Some understanding of the relationship between host, parasite, and environment is essential for the proper assessment of possible control measures. The fungus has only been grown upon living tea leaves and stems. No other host is known in Ceylon. The airborne spores, produced in vast numbers, undoubtedly perish in vast numbers. But under suitable conditions a proportion

alight upon tea leaves and germinate there, normally on the under-surface. The germinating-spore produces a hypha which enters the leaf tissue and ramifies there. After about ten days, a small yellowish green translucent spot is produced. Some substance produced by the fungus causes local growth of the host, with the result that a circular crinkle, or blister, is produced. About a week or so later the fungal hyphae burst through the cuticle on the under-side of the leaf and very numerous spores are formed. It is this process which gives the white, doughlike appearance to the blisters. The spores are carried away by the wind and, if conditions are favourable, a vast increase in infections results; it is the same phenomenon, in fact, as Dr. Gadd has already described to you in relation to insects, but with possibly even vaster potentialities.

As in the study of insect pests, the host as well as the parasite must be considered. From the accumulated experience in Ceylon it appears safe to say:—

- (a) Young tissues are far more susceptible than old.
- (b) Young leaves are the most frequently attacked, but the damage done is greatest when the young stem is infected, causing the distal portion to die.
- (c) Bushes vary considerably in their liability to the disease and there are, as to be expected, already indications of clonal variations in this respect. Low jat, *under equivalent conditions*, is often said to be more resistant than high, but no generalisation can be made. For example, clones 26 and 1294, low jat types, appear more susceptible than clone 25 so far.

- (d) The amount of damage done depends on the proportion of young to mature growth. Liability is therefore greatest after pruning, especially after severe pruning.
- (e) At elevations below 3,000 feet, the value of lung pruning is enhanced because of the danger of losing the primary tipping shoots.
- (f) Last but not least there is, most fortunately for us, something that limits the growth of the fungus within the bush. Whether it be some process of auto-intoxication, or the production of some compound unfavourable to its growth, the fact remains that the fungus is strictly confined. It is interesting that the development time of the blister increases with the age of the leaf.

We now pass from parasite and host to the influence of external conditions upon their relationship. It is now commonly accepted that dry weather is prejudicial to the disease and wet weather favourable, as in North India. It is important to remember, however, that the fungus is quite uninterested in *our* conception of weather. The spores are produced and ripen in a micro-climate in which temperature, humidity, etc., are quite different from those obtaining even a fraction of an inch away from the leaf. Only when airborne, does the spore come into contact with conditions nearer our conception of the prevailing "climate." But as soon as it alights, if it is fortunate enough to do so, on the under-surface of a young leaf, it attains once more the conditions of its original birthplace. On germination and entry into the leaf, it becomes safe from the vagaries of the climate and also, be it noted, from our hos-

tile acts, until the fruiting stage is reached once again.

A few moments' consideration of this outline of our knowledge of the disease will convince everyone that there are strict limitations upon the control measures that can be taken if they are to be economically justifiable. Naturally that standard is not a hard and fast one — the worse the disease the further one is prepared to go to fight it.

Spraying is the first method of control that springs to mind. But any one who has sprayed the fruit trees at home knows that it is an easier thing to advise than to do. Consider, too, that the spray will only protect existing leaves, and that much of the labour of spraying will go to protect leaves already relatively resistant by virtue of greater age. Consider again that to be effective, not one spraying, but many will be necessary. And even as you spray new leaves will unfold, and new airborne spores arrive to infect them. Remember we have had drastic evidence that infection may arrive from afar and spread very quickly. But if the fungus were to be found to be dependent on, say, a particular period of favourable conditions to enable it to spread, and if this period were predictable in advance, spraying of bearing tea might be desirable. Experience may force us to spray tea recovering from pruning to enable it to retain the leaf surface essential to recovery. But it must be remembered that spraying after an attack has become severe is partly wasted, owing to the large number of invisible infections safe within the host tissues.

In contrast, the spraying of nurseries is desirable since spraying can be repeated cheaply, and the danger of taints does not arise. If spraying is delayed until the fungus is visible, then you must expect further

infections to show themselves, perhaps in great numbers, during the ensuing twenty days. Spraying is advisable once towards the end of the dry weather and then, subject to experience, once a week during fair periods. It is essential, it may be noted, to wet the under-surfaces of the leaves, a small handspray with a fine jet being sufficient for the purpose.

Picking affected leaves is, of course, an easy and widely used method of control but even here its practical limitations must be recognised. It is only feasible and only effective as a palliative when attacks are relatively light.

I have already suggested that Blister Blight makes heavy pruning of any sort an even more obnoxious practice than it is already. The presence of the disease renders the practice distinctly risky, until we know whether the replacement shoots will survive the disease long enough to obtain immunity with increasing age. Far greater insistence on preserving the spread of the frame, possibly reinforced by lighter pruning and retention of more "points" on the bush, will be necessary if assurance is to be obtained against the obvious risk of loss of frame subsequent to death of tipping shoots. The bush being most vulnerable in the recovery period, it may prove desirable in the districts receiving the S.W. Monsoon to prune so that the tea is shooting by the end of December or early January, so that during February and March, some leaves may mature and pass the period of extreme susceptibility. In addition, if the disease proves to be a serious factor in the future cultivation of tea in Ceylon, particularly in the early part of the cycle, then our present conceptions of the best length of cycle for a particular field or estate will have to be recast in the light of experience in the new conditions.

In so far as shade protects the fungus during the vulnerable periods, it is frequently desirable, where the shade is heavy, to reduce it temporarily by lopping. But any programme of hasty cutting out is to be deprecated. The presence of shade is of little importance on a sunless, misty day of high humidity. It is probably most likely to aid the fungus during periods of intermittent sunlight, and during the transition to and from the dry weather period.

It appears that the fungus is subject in nature to a very delicate balance of favourable and unfavourable factors. For example, through the co-operation of a number of those estates which reported attacks in October and November, details were obtained of the weather conditions during the infection period. In spite of the fact that some estates suffered badly while others had few bushes affected, no consistent differences in the macro-climate were observable. The only evidence obtainable was that heavy rainfall did not prevent the spread of the disease, though it is unknown whether it reduced its severity.

That small differences in local environment can exercise a most striking effect is illustrated by data from plots at Passara. These plots are situated on a slope rising from the banks of a nearby stream. The plots nearest the stream suffered more severely than others only a few feet higher and further from the stream. This phenomenon can be generally observed in hollows and such like places. It is well known that such localities fill, every evening, with saturated air in which condensation of water occurs as the temperature falls, and it is possible that the occurrence of saturated air, or genuine mist formation, over a period exceeding twelve hours may be of importance. Indirectly, also, aspect may have an effect, since early sun considerably

reduces the wet period. As you know cool, damp spots of air may be found in hollows in the lee of jungle belts relatively late in the morning.

It is recommended that each estate commence the deliberate accumulation of data upon the *local* distribution of the disease, both *geographically* and *seasonally*. For example, if you have noted that the disease in a given field has been more abundant in a certain hollow, protected by trees from the early sun and heavy shade, it should be noted in a log. If it is found to recur there with severity, it will be necessary to attempt to change the local climate by, say, cutting out the trees. It is suggested that a monthly record be made of the spots in each field in which the disease is worst, provided such spots are made permanently identifiable; action taken should also

be recorded for future information and guidance, together with the results obtained.

To predict the future course of this disease would be foolhardy. To the pessimist I would point out that both North and South India take a calmer view of its potentialities than they did earlier, and that we in Ceylon can congratulate ourselves for the moment on the relatively mild nature of the disease so far. To the optimist I would say that we cannot say we are out of the wood until we know what the disease will do in the South-West Monsoon. To all, I must emphasize that, for the present at least, Man is not the deciding factor in the disease, but Nature. When we know more of all the factors engaged, we may be able to influence the balance. To aid in that, we desire your continued assistance.

## DISCUSSION

A lengthy discussion followed, during which the following statements were made, mainly by Dr. Tubbs in reply to questions.

There was no connection between peach leaf curl and blister blight of tea although there might be certain resemblances. Peach leaf curl was caused by a species of *Taphrina* (*Exoascus*) whereas the fungus that caused blister blight was *Exobasidium vexans*. The latter fungus was not known to occur on any other host than tea, though related but different species had been found on rhododendron in Ceylon. How the fungus arrived in Ceylon was unknown, but it reached there shortly after being first reported in South India. It seemed unlikely that tea seed was the source of infection, as its import

into Ceylon had been prohibited for many years as a precaution against introducing that particular fungus with the seed. South India had also remained free from this disease until last year, although there was no prohibition against import of seed from Assam.

The blister became infectious as soon as the cuticle on the lower side of the leaf ruptured to disclose the white fungus beneath. How long the spores might remain viable on the surface of a leaf during an Uva drought was unknown, but the spores were reputed to be short-lived. The question might be only of academic importance as, allowing that the drought killed all the spores, there would still be risk of reinfection from elsewhere, as happened last year.

Young leaves were undoubtedly the most susceptible, but with increasing age the leaves became more resistant and less liable to infection. For that reason blister blight had in general been worst in recently pruned fields. Yet, recently pruned fields were not all severely attacked. The severity of attack depended to a large extent upon local conditions and it was not always possible to explain why certain fields were more severely attacked than others. The relatively severe outbreak of the disease on 2-year-old tea growing on the top of a ridge where there was very little shade, as reported by Mr. G. E. D. Foster, was somewhat unusual and could not, in the light of present knowledge, be explained, unless the area was subject to mists.

Late tipping was not recommended as it left a large quantity of infectable material on the bush for a longer period, so affording ideal conditions for rapid multiplication and spread of the disease when climatic conditions were favourable. It therefore seemed preferable to tip earlier, but not lower. Early tipping during dry periods would stimulate the production of secondaries and tertiaries, which might have time to mature and become resistant before climatic conditions again became favourable for the fungus.

Neither early tipping nor short rounds would entirely eliminate the disease from young fields as there was a good deal of infectable young growth below the plucking surface. In older fields the young growth was mainly, though not entirely, above the plucking table, so short plucking rounds would keep the amount of infectable material at a minimum. It was on record that, in India, the harvesting of the greater portion of the third leaf, together with the bud and two leaves above it, reduced the incidence of the disease and maintained

crop. Apart from the 'coarse' plucking, the method reduced the area of infectable leaf on the bush, without reducing the number of buds available for further growth. The temporary *eradication* of the disease by completely stripping every piece of young growth from every bush at intervals shorter than the incubation period of the fungus, while theoretically possible, was in practice impossible. Even were it carried out, there would still be risk of immediate reinfection in the same way as in 1946 either from abroad, from abandoned areas, or from some overlooked source.

One of the most convenient compounds for spraying on the bush to give protection to foliage was 'Perenox.' This was normally obtainable in Colombo at Rs. 1-25 per pound, but supplies recently had not kept pace with the demand. It was prepared for use by stirring the powder into water at the rate of 1 ounce to 2½ gallons of water and was thus far easier to prepare than were Bordeaux or Burgundy mixtures. The frequency of spraying depended largely upon the rate at which new infectable leaves and stems were formed. Spraying protected existing leaves from new infections, but not from those which had already occurred. As new leaves were produced further spraying should be carried out when periods of suitable weather occurred. It would not always be possible to spray effectively during the South-West Monsoon. The amount of copper reaching the soil as a result of using copper fungicides would never, under normal circumstances, be sufficient to injure the fertility of the nursery. Hexylresorcinol had not been tested against blister blight, but from the information available its high cost would rule out its general use even if it proved effective.

Spraying of young fields in Uva during the dry months was not recommended as

its efficacy would not be sufficiently great to be economic. At such a time the climate would be giving a more effective control. Collection of infected leaves should only be done at times of low incidence and be as thorough as possible. It should not be confined to infections on young tissues alone.

There was no evidence that manures made bushes either more or less susceptible to the disease. In the instances given during the discussion the interval between the application of the manure and the appearance of the disease was not sufficiently long, in Dr. Eden's opinion, for the manure to have had any effect on growth. Its effect on growth would almost certainly occur before any change of leaf structure or composition affecting susceptibility became evident. When manures had stimulated the bushes, the presence of the extra young and susceptible growth might give the impression of increased susceptibility when conditions were favourable for the fungus. Until more was known of the seasonal incidence of blister blight in Ceylon no rational adjustment of manuring programmes could be recommended. That subject would require consideration when the facts relating to it were known.

So far the disease had caused no severe general loss and that loss was of crop rather than of bushes. On the whole the damage had been less than that expected. Although the climates of Ceylon and S. India were somewhat alike the damage, according to reports from S. India, appeared to have been greater there. That might have resulted from heavier shade. A fungus however could distinguish, and would respond to, differences in climatic conditions that man would not notice, and for that reason it was unsafe from knowledge of a fungus in one country to predict its exact behaviour in another.

Mr. G. M. Oakes, invited by the Chairman to give his experience of the disease in Assam, stated that the disease was controlled there mainly by natural factors. It was usual in most districts in Assam to spray against red spider with lime sulphur solution during the cold weather, which was also the dry weather, but whether that had any effect on blister blight he could not say. Pruning was also done during the cold weather. The climate was very different from that in Ceylon. His experience in Assam was not extensive but he had never seen nor, he thought, had Tocklai ever been called upon to deal with the disease on the scale that had occurred in Ceylon.

Dr. Gadd said that there appeared to be an idea that blister blight could be eradicated. If so, it should be forgotten. Now that the disease had arrived in Ceylon it would remain there. That did not mean that the disease would necessarily always be of serious importance. By suitable control measures a major pest could be reduced to minor importance, but rarely, if ever, could it be eradicated. Instead of thinking of eradication they had to consider control by cultural or other methods, which would reduce to a minimum the damage caused by the fungus. Any scheme by which an attempt was made to collect and destroy every infected leaf would only prove futile. A minute quantity of spores somewhere would surely be overlooked. He asked them to consider how much infectious material originally entered Ceylon last year. He did not imagine that it could have been any appreciable quantity. It may have been only a few spores, microscopic in size. Yet after two or three months the fungus could be found, only too easily, in practically the whole tea area of Ceylon. That experience clearly showed how rapidly, when conditions were favourable, a small

amount of the fungus could increase and multiply and spread over a large area. It also made evident how impossible it would be to eradicate such a fungus.

The problem was one of control not eradication. Climate was undoubtedly the most important factor affecting control but it might be necessary to assist nature by cultural or other methods, even perhaps by spraying, which he hoped could be avoided, except perhaps for nurseries. He hoped that his emphasis of this point would not be misunderstood. He was not pessimistic about the disease as he believed that it would be effectively controlled though not eradicated.

Mr. Kenneth Morford said that Dr. Gadd in his opening remarks had indicated a shortage of senior staff at the Institute and the difficulty of obtaining more scientific officers. He recognised that these conditions might prevent the necessary attention being given to blister blight and any development which might arise in connection with that disease. Dr. Tubbs had fairly stated that what might happen during the South West Monsoon was unknown. He (Mr. Morford) felt certain that all were anxious and desirous of some assurance that should it be necessary for an officer to be relieved of all other duties in order to devote himself solely to the study of this pest and to travel here and there whenever necessary, an officer would be freed and given facilities to do so. His District Planters' Association had passed a resolution to the effect that steps should be taken to ensure that an officer would be free to give his whole time to blister blight. It may be necessary for someone else, not necessarily a scientist but perhaps an amateur scientist to act as 'locum' for the senior officer who had to devote himself to this menace. But whatever arrangements had to be made he asked, with the full

support of the Conference, that work on blister blight should be given priority.

Dr. Gadd assured Mr. Morford that the subject of blister blight would not be neglected. Since the outbreak of the disease, apart from the time he himself had been able to devote to the subject, Dr. Tubbs and the staff of the Mycological Division had concentrated on the study of that disease. That work would continue till the facts were known. Their job was to get the facts, though often that proved a slow process. They were not prepared to say what was going to happen during the next South West Monsoon period nor even during the next North East. They must wait to see what would happen then and to ascertain how the fungus would behave under those conditions. That could not be foretold with any certainty but that sort of information was essential for rational planning. The study of blister blight would be given priority until the most efficient control measures had been devised.

In reply to a suggestion that an officer be sent to North India to study the disease there, the Chairman (Mr. Singleton-Salmon) said that it did not seem to him quite logical to send one of their overworked officers to a place where the disease had occurred for over ninety years. He would not personally go to a doctor who had failed to cure something for ninety years. What had to be studied was the behaviour of the disease under Ceylon conditions.

In response to a question concerning what the Government proposed to do regarding blister blight, the Chairman said that he could not allow that question to pass to the scientific staff as not even the best of scientists nor any man could know what any Government would do at any time.

Mr. R. F. Greer said that the Government obtained a large part of its revenue from the Tea Industry, and consequently any severe damage by blister blight would cause loss to Government. It seemed to him that the occurrence of this disease in Ceylon and the work on controlling it was a matter for Government assistance. He understood that Government made no direct financial contribution towards the research work of the Institute, and it seemed right and proper that Government should give financial help in the form of a subsidy to aid the Institute and the Industry in controlling this disease.

The Chairman said he would take up the question with the Board of the Institute.

Mr. R. Brodie, speaking for those living in the south of the Island, said that they often would like an officer from the T.R.I. to come and advise them on the spot. He knew of the shortage of staff but wished to suggest that more use should be made of

the Small Holdings Officers. These officers were resident in different districts and he thought that their services should be made available not only to small holders but to estates as well. He suggested that they be given a more thorough training at St. Coombs and made competent to give advice on estates as well as small holdings.

Dr. Gadd said that he would be very pleased for planters to make use of the services of the Small Holdings Officers in connection with this disease and he felt sure that the officers themselves would be very willing to assist in every way possible. The Small Holdings Officers' work entailed a good deal of travelling and their trouble still was the smallness of their petrol ration which to a large extent limited their activities. He assured Mr. Brodie of his co-operation in making the services of the Small Holdings Officers available should estates require them.

[The further proceedings of the Conference will be printed in the next number of the *Tea Quarterly*.]