

# THE CONTROL OF BLISTER BLIGHT OF TEA\*

(*Exobasidium vexans*, Masee)

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## I. INTRODUCTION

Perhaps the title of my lecture today may appear rather audacious but, in my opinion, it is not, provided control is interpreted as the limitation of the damage inflicted to the extent that economic factors allow. I think the time has come to summarise our present views upon the control of this disease, whose possible menace to the Island's revenues as a whole requires no emphasis, and to stress once more that we neither know of, nor expect to find, any *single* master cure. Limitation of the damage inflicted by the disease will only be achieved by the combination of many measures, appropriately varied according to the district, estate, season, and condition of the tea. It is fundamental to my approach today that I hold out hope, not of eradication or cure, but of control.

The use of a single method of control is attractive by virtue of its simplicity, and it is therefore desirable to illustrate the weaknesses inherent in such a narrow approach to the problem. Humid conditions, as you all know, favour the occurrence of this disease. Thus field observation shows that during what we may call the "North East" conditions of sunny mornings, showery afternoons and clear, cold nights the disease persists mainly in four types of locality when it is considerably reduced elsewhere. These are: in hollows where cool saturated air lies at night, over areas of damp soil where moisture arising at night from the warm earth condenses on

the under-surface of the colder leaves, in the lee of jungle areas from which cool, wet air currents tend to flow, and under heavy shade where the effects of a passing shower are greatly prolonged. Where, however, widespread mist or humid conditions prevail as in the South West Monsoon, infection occurs over much larger areas, often on hill tops, and apparently quite independent of shade, hollows, jungle, or damp soil.

From the practical point of view, shade reduction markedly reduces blister blight when sunny conditions prevail, but it will be obvious from the foregoing that it only requires a period of misty weather to cast a superficial doubt on the value of the measure. But control measures must be based on the average, just as you prune the whole of a field at one time ignoring the fact that a few bushes have 'run-out' long before. Shade control provides a good example of a measure to whose undoubted general usefulness frequent apparent "exceptions" following upon the intrusion of other factors of temporarily greater importance are to be expected. A "single method" approach to the problem of the control of blister blight provides no protection against such "exceptions" which can only be met by a combination of several measures.

## II. THE DISEASE

To appreciate the lines along which the field control of blister blight must be developed, the life-history of the fungal organism responsible for the disease requires study. The disease is spread by airborne spores, so

\* Text used as the basis of a lecture delivered to the Low-Country Products Association, Colombo, on 17th July, 1947, and of lectures to numerous District Planters' Associations.

numerous that the factors limiting its increase are normally those of host and environment, *not* the number of potentially infective spores. This is shown by the occurrence of sudden, locally circumscribed outbreaks at times when the disease is generally at a minimum, by the absence of any observable 'zoning' of infections around highly infected bushes and by the ineffectiveness of local control measures in reducing potential local infection. These spores germinate under conditions of very high humidity, or in very thin films of water. Whether or not an infection follows germination depends upon whether the spore has chanced to alight upon a tea bush, how "resistant" is the individual bush concerned, whether the portion of the host on which the spore rests is *young* and thereby susceptible, and, equally important, whether external factors such as temperature, humidity, light, etc., remain favourable long enough for entry into the host to be achieved. Once entry has occurred, probably in under twenty-four hours in some cases the fungus is safe from weather and from all artificial attack save that of the plucker, until the blister is formed about 3 weeks later. Where the youngest host tissues are attacked, however, the fungus may be defeated by their hypersensitivity, blister formation being prevented by the incontinent death of the host tissues. In older, but still susceptible organs the host tissues achieve sufficient resistance to the invasion of the fungal hyphae to strictly localise the area affected.

From the foregoing it follows that partial control of the disease, in theory, can be achieved by prior protection of the young susceptible tissues, by reducing periods favourable to the disease to less than 24 hours (shade reduction) and by growing clones of greater inherent resistance.

Before further examining these lines of control, we must take into account the type of damage done to the tea bush, and the periods when damage is greatest. The damage is greatest when young buds or stems are affected, death of the whole shoot, or that part of it above the point of infection, following. The consequences may amount, in bad cases, to almost complete loss of crop for weeks, or to a delay in the recovery of pruned fields of many months. Leaf infections cause less damage, since it is only a portion of the assimilating surface that is affected. Since the greatest proportion of infectable tissues occurs in fields recovering from pruning, and since damage at this stage can postpone or reduce yield for many months subsequently, it follows that our interests are most vulnerable in the pre-tipping fields. It is here, therefore, that control measures are especially necessary.

### III. FIELD PROGRAMME

The most important natural controls of the disease in the field are high temperature, dry air, maturity of host tissues and possibly light. Subsidiary factors such as attack on the blisters by insects or by other fungi, and the partial resistance of some bushes do not really affect the general issue at present, though the premature germination of spores before they have left the parent blister may well be of importance under very humid conditions.

The cheapest method of controlling a disease is usually to adapt the details of ordinary agricultural processes to meet it. Since tea is cropped throughout the year, seasonal liability to the disease cannot be avoided. But the field programme can be adapted to allow of the bush passing through its most vulnerable period with the minimum of risk by arranging for "dry weather recovery" to take place over as

large a proportion as possible of the acreage pruned annually.

The second use that can be made of natural characteristics of the disease is to avoid risking the removal of a large part of the immune stems on the bush, merely to await their replacement by susceptible tipping shoots. This involves leaving many more points, and possibly pruning at a higher level than normal. Obviously, such measures are the more desirable the greater the risk of blister blight infection, *e.g.*, whenever wet weather recovery is risked. In such cases, the advantages resulting from cutting-across deserve serious consideration as a matter of interim policy.

A cut-across at the normal pruning level results in rapid recovery and earlier tipping, while a cut-across immediately above the previous tipping level allows of the immediate reformation of the plucking table, provided soft banji is dealt with by early plucking and short rounds. That the mass of young leaves so produced may suffer a heavy infection is no argument against the method, since the same would occur were so many "third leaves" available for blister development on a bush previously pruned in any other way. It may also be noted that the speedier recovery from pruning that results from light pruning can also be used to increase the acreage recovering during dry weather.

A further point concerning methods of pruning to be adopted is that lung pruning should be adopted on estates below 3,000 feet. Above 1,500 feet, some competition between lung growth and tipping growth may occur if lungs are left unplucked. In such cases about half the lungs may be cut back to form a leafy fringe at an intermediate stage of recovery. The lungs should be cut back to the tipping level or above, leaving as much 'spread' as

possible, only after the bases of the tipping shoots have safely matured to a point where they are no longer susceptible. Lung pruning is normally unnecessary above 3,000 feet, even as a precaution against repeated attacks of blister blight, fringe pruning to maintain the spread being sufficient.

The early formation of a canopy of new leaves upon the pruned bush may also be encouraged by *early* tipping — in fact, by plucking as shoots arrive at the tipping level. The further advantages of this process are that backward shoots are encouraged to grow more quickly, and that secondaries at all stages of growth are found later, so that some, at least, are less vulnerable when a subsequent attack occurs. Early tipping and light pruning both result in increased yield in the pruning year, and thus may compensate, entirely or in part, for losses from blister blight, which are normally greatest also in the first year after pruning.

These points were more fully discussed in my lecture to the Nuwara Eliya Planters' Association, to which some of you may care to refer, but I would like to add this important point. Neither method of pruning, time of pruning, nor method or time of tipping can be expected to protect new growth on the bush for the rest of the year. The value of these measures, direct and indirect, lies in helping to ensure the speedy return of the bush to full *potential* yield. What happens afterwards is on the lap of the gods, but at least it cannot be as serious as the loss of all tipping shoots, on successive occasions, over large acreages. Of course, protection is never absolute, for if a long wet period were to occur in the middle of a normally "dry period," damage in recovering fields would be almost certain. But this cannot be said to destroy the value of dry weather recovery in an average year ;

it only marks our lack of control over the elements.

The only agricultural protection that can be given to fields in plucking is to control the density of shade, especially when periods of sunlight are expected, and to pluck closely during periods of attack, reverting to normal plucking when feasible. There is very little point in leaving the "third leaves" during *bad* attacks, no matter what one's views on plucking are under normal circumstances.

The alteration of agricultural programmes to conform with the foregoing principles may involve direct or indirect loss; therefore the estimated cost must be balanced against the expected loss from blister blight under the particular circumstances of individual estates and fields. If you decide to accept the latter loss, then it must be remembered later that it was accepted as a business proposition, on which you did, or did not, lose more than expected. The Institute has made it abundantly clear that it considers that the risks arising from blister blight in fields recovering from pruning at elevations above 1,500 feet fully justify the strictest precautions until sufficient experience has been gained to allow of a decision as to whether the risks in a particular estate or district are sufficiently small to justify relaxation.

Reference may be made in passing to the blister blight records now widely kept by estates with a view to facilitating the adjustment of estate programmes. Since the record is intended as a guide to the future treatment of the whole field or area referred to, it is of course essential that the category recorded should be the average of the field or area as a whole, and not refer merely to the condition of a small badly affected area within it. The importance of

these records has been stressed by the Chairman of the Board of the Tea Research Institute in his letter of 18th June. I would only add here that everything we have learnt about the fungus, either from laboratory investigation, field experimentation, or estate experience, points to blister blight only being capable of serious damage when a very delicate balance of environment and host factors occurs. Since many of these factors are not within our control, it is of great importance to accumulate such careful records of field-to-field experience as will allow of the correct local use of those we can control, such as time of shade-logging, time and type of pruning, earliness of tipping, length of pruning cycle, etc.

#### IV. SPRAYING AND DUSTING

You will remember an earlier reference to the shortness of the period during which the fungus is vulnerable, *i.e.*, the period between spore germination and entry into the host tissues. The means of *artificial* control available to us at present are based upon harming the fungus before it enters the host and are thus protective, not curative. The fungicidal compounds available may be applied to the bush either by dusting or spraying. The former is usually a less effective method of application, but is cheaper in labour. The great weakness of both these methods is that each new leaf or portion of stem as it unfolds must be protected before it is infected. To do this would require such frequent treatment that there is, in my opinion, no chance that it will ever be an economic proposition to protect the tea *crop* by such artificial means unless some undreamt-of advance occurs.

But if protection over short periods, such as during recovery from pruning, can have long term effects, it may become economic to adopt measures that would

otherwise be too expensive. It is therefore necessary to consider the cost of obtaining protection and balance it against the advantages anticipated. The cost of spraying varies very greatly with the availability of water, while that of both spraying and dusting is affected by terrain, the size of the bush, whether or not the rows are on the contour, and the keenness of the subordinate supervision.

The following data are only approximate but give a reasonably complete interim picture of the costs involved.

(1) *Protection of plants in young clearings.*

Seedlings 0-12 inches in height, in contour rows, 5,600 plants to the acre.

A. Spraying.—1 cooly per acre ; 1½ oz. Perenox per acre (per treatment).

B. Dusting.—½ cooly per acre ; 10 lb. per acre (per treatment).

(2) *Protection of young clearings during initial recovery after centring.*

As only the shoots produced on the pruned stems are of especial interest, spraying or dusting of mature leaves, etc., should be avoided. If this is done, the cost should not exceed that of treating young seedlings.

(3) *Protection of young clearings during initial recovery after the first pruning subsequent to centring.*

A. Spraying.—Preliminary figures obtained on a well grown young clearing, in contour rows, 5,600 bushes to the acre.

2 coolies per acre, (i.e., one cooly spraying and one for relief, water carriage, mixing, etc.)—(per treatment).

1 lb. Perenox per acre (i.e. forty gallons of spray).—(per treatment).

B. Dusting.—No figures available — probably in neighbourhood of 1 cooly and 15 lb. of dust per treatment.

(4) *Protection of mature tea during initial recovery after pruning.*

A. Spraying.—\*4-6 coolies per acre, including water carriage, etc. ; 2 lb. Perenox per acre.—(per treatment).

B. Dusting.—2 coolies per acre ; 20-30 lb. of dust per acre.—(per treatment)

(5) *Protection of shoots on mature tea in bearing and of clonal bushes rested for growth of propagation material.*

Provided only those shoots in the immediate vicinity of the plucking table are treated, the cost is not likely to greatly exceed that in tipping fields, where shoots have to be dealt with in all parts of the bush. Protection of the growing tips (only) of shoots on large bushes rested for the growth of propagation material has required labour and materials at the rate of 2 coolies per acre and 1-1½ lb. of Perenox.

(6) *Protection of Nurseries.*

Young seedlings are infectable at the earliest stages of growth and therefore require early protection. The cost of weekly spraying is almost negligible, particularly if a light, fine spray is applied to both surfaces of immature (susceptible) leaves *only*. Heavy application of fungicides only leads to "run-off," from which copper poisoning of the soil followed by stunted growth of the seedlings may result.

The cost of one copper spray, Perenox, used at the rate of 4 ozs. in 10 gallons is at present Rs. 1-70 per lb. A dust, Perelan I, costs 90 cents per lb., and other dusts and sprays are becoming available at prices yet to be ascertained. The lower cost of fungi-

\* I am indebted to Mr. Manning, U.P.A.S.I., S. India for a figure of 4 coolies per acre when large trained gangs are employed

cidal dusts, and the lower labour costs involved in their use are offset by the larger quantities required to obtain efficient protection. The cost of application of both sprays and dusts may, however, be subject to drastic revision if new or more efficient appliances are developed.

The frequency with which spraying is necessary materially affects the cost of obtaining protection. Weekly spraying, based on an average production of one new leaf a week on non-banji shoots, was found to be effective in practice, but comparison of the effects of spraying at longer intervals has not as yet been experimented long enough to justify definite conclusions. About ten sprayings would be required if weekly spraying were to be continued from budbreak to tipping in the case of bearing tea or to ripening of the bases of the young primaries in the case of young tea. This would involve relatively small expenditure per acre in the case of young pruned tea, which could be further reduced by arranging to combine dry weather recovery with a shorter subsequent period of weekly spraying. The cost of protecting young clearings also appears quite small enough to justify prior protection where damage from blister blight is anticipated, since the disease can cause the death of large numbers of young plants in their early stages.

Bearing tea, however, is in an entirely different category. An expenditure on pruned fields of from Rs. 10 to Rs. 15 per acre, repeated on some ten occasions, would appear unjustified under normal circumstances. Take for example, a field first sprayed in July, in one of the 'South West' districts, after having been pruned in April and having had all the tipping growth killed off by blister blight, and postulate the worst case, i.e., that the disease is severe until the

end of 1947. If the yield in its first year would normally have been, say, 700 lb. per acre, the yield to be expected from July to the time of dry weather comes in January, 1948 might be taken as, say, 400 lb. Of this, 3 months' yield is already irremediably lost, since a practically fresh recovery has to be made. Therefore, by protecting the new growth from July onwards about 200 lb. per acre might be saved, but if protection was only given for the 3 months up to tipping, some even of this would be lost. The total saving might then be, say, in the neighbourhood of 150 lb. per acre. Assuming a potential nett profit per pound less cost of plucking and manufacture (which is saved while the field is out of production) of 40 cents, about Rs. 60 is the maximum sum that can be profitably expended. This would be insufficient to cover the cost of spraying for three months.

In passing I might mention that dissatisfaction with spraying can result from commencing protection too late, too heavy application, spraying of old tissues as well as young, rainfall during spraying or before the deposit has dried on the young shoots, sprayers giving too coarse a mist, and from insufficiently frequent application. It is also often forgotten that blisters will continue to develop for about three weeks after the commencement of weekly spraying from the infections already latent, but safe within the tissue of the host, at the time of the first spraying.

The compounds I have referred to so far are copper fungicides, as the risk of taint arises if sulphur compounds are used. Sulphinette may be used for nurseries, but sulphur dusting is ineffective in controlling blister blight.

As regards the fungicidal compounds available, I understand that the products of

Imperial Chemical Industries, Messrs. Strawsons (Brown & Co.) and of the Swiss Sandos Firm (Baur & Co.) are either available or expected. The price factor per acre per treatment requires consideration in each case. In this respect, it may seem rather astonishing that a country so dependent on revenues from its major industry should still levy import duties of from 15 per cent to 25 per cent upon spraying and dusting apparatus and upon fungicidal compounds for the use of the industry. This is a subject which is more than ripe, I suggest, for official reconsideration.

Before concluding I will refer, briefly to our results on another subject — that of the influence of manuring on blister blight. Additional manuring, by raising yield, in blister-free periods, may compensate to some degree for losses from this disease. But from an extensive series of records, collected with Dr. Eiden's co-operation from the Passara manurial-experiments, no indication whatever was obtained that either supply or starvation of phosphate (30 lb. per acre per annum), nitrogen (40 lb.) or potash (20 lb.) for a continuous period of twelve years had led to any resultant 'immunity' or 'resistance.' It can be said, with reasonable certainty, that whatever effects may or may not be found in future, the data already obtained indicate that it is not in this easy way that salvation from blister blight is to be obtained. In fact, we have to face the fact that vigorous, high yielding tea, by virtue of its greater proportion of young tissues at any one time, is likely to suffer from a higher total of infections, and has in fact been found to do so.

#### V. CONCLUSION

To summarise the present position, I would emphasise that so far I have received no information that would suggest that

stringent measures are immediately necessary at elevations below 1,500 feet, but until we know whether the disease will be more serious at these elevations later in the South West Monsoon, no generalisation is, of course, possible. Above these elevations the adoption of the following measures are recommended according to the degree of blister damage that is apprehended in the particular circumstances of an estate or division. In this connection it must be emphasised that "upper divisions" above a seasonal mist line will require more radical measures than lower divisions enjoying a sunnier climate.

- (a) Concentration of the pruning programme to obtain dry weather recovery from budbreak onwards, for as long a period as feasible.
- (b) Light pruning at the end of dry period.
- (c) Much lighter pruning when fields are made to recover in seasons favourable to blister blight.
- (d) Fringe pruning at elevations above 3,000 feet, merging into lung pruning at lower elevations.
- (e) Careful choice of those fields, if any, that are still pruned for wet weather recovery as regards aspect, lie of land, and permanent shade.
- (f) Early tipping of all pruned fields as they recover, but not at a lower height above the pruning level than normal. Side branches (fringe) or lungs should not be shortened at low elevations until there is a good canopy of new leaf on the bush, and even then not below the tipping level.
- (g) *Short rounds*, with closer plucking when blister is frequent.

- (h) More frequent lopping of medium shade to take full advantage of all dry periods, thinning of high shade where necessary, and increased use of green manures with a view to avoiding any reduction in the amount of green stuff available for incorporation at forking time.
- (i) Regular spraying, prior to and during weather favourable to the disease, of nurseries and of *young* clearings, temporary spraying of young pruned fields if recovering in wet seasons, and possibly of supplies, provided that tests to ascertain costs per acre under local conditions have indicated that it will be worth while.
- (j) Avoidance of excessive applications of fungicides, *i.e.*, to old leaves, or in sufficient quantity to lead to "drip," especially in nurseries.
- (k) Selection of clones for resistance to blister blight.

There is no one measure that will give complete protection ; only a judicious use of all these measures can be expected to reduce the effect of the disease to the minimum feasible at an economic cost. To this end, facing the unpleasant fact that the minimum may still in some cases be uncomfortably large, the agriculturist must adapt his measures. On our part, our search for new lines of attack on the disease, and for new and cheaper methods of control, will, we can promise, continue to be vigorously pressed forward.