

## NOTES ON BLISTER BLIGHT

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The very large amount of visiting and advisory work involved in dealing with the problem of blister blight inevitably draws attention to numerous points requiring further clarification or emphasis. The following subjects are dealt with in note form, any connected account being as yet premature:—

### 1. RED BLISTERS.

The occurrence of red blisters was noted and portrayed by McRae in North India as early as 1910. In Ceylon they have been known since the disease first arrived in the Island. Any suspicion that they represent a more "virulent" type of the fungus can be allayed. The formation of a red blister is dependent upon the characteristics, not of the fungus, but of the particular tea bush. Those bushes having a tendency to the production of pigment, especially as a wound reaction following upon attack on a sucking insect or other injury, form red blisters. The relationship between 'red blister' and particular host plants is illustrated in the St. Coombs clonal plots where all bushes of clones 1005 and 1082 display coloured blisters, while many other clones display no such tendency. The density of coloration varies from clone to clone. The colouring matter is present in the cell fluids of the host, and not in the fungal hyphae. The attacks on clones 1082 and 1005 gave no indication whatever of any greater 'virulence,' it may be noted. Bald's\* reference to red blister is erroneous.

### 2. ATTACKS IN 'OLD' TEA FIELDS.

Emphasis on the need for protection from blister blight of fields recovering from pruning has led to the assumption that the flush of 'old' fields is more resistant and thus

to fears, when attacks are observed in 'old' fields, that a more virulent type has emerged. It should be noted that the only tissues attacked are young, and that as yet we have no evidence that tissues of the same youth differ in susceptibility, according to whether they have developed on 'old' or on freshly pruned bushes respectively. The presence of blisters on apparently mature leaf results from infection rather late in the development of a young leaf, in wet or cloudly weather. The blister does not appear for some three weeks, by when the leaf appears relatively mature, and may then persist during wet weather for some time on the ageing leaf

### 3. RESISTANCE OF INDIVIDUAL BUSHES AND OF CLONES

Variations in resistance between individual bushes in the field are often very marked and are paralleled by similar differences between different clones. The following data from the clonal plots at St. Coombs are based upon a total of twenty recordings at nine day intervals, i.e., approximately six months. The clones referred to were grown under similar conditions and without shade. They were pruned in May, 1946, the records being from 28th January to 15th July, 1947, during which time they were plucked on regular nine day rounds. The relatively low blister counts are due to the effect of the dry weather, absence of shade and regular rounds of fairly close plucking. The marked varietal differences in susceptibility render obvious the value of selection of clones according to their resistance to blister blight.

\* C. Bald—Indian Tea, Its Culture and Manufacture, Calcutta, 1940.

Clones	Mean blisters per bush per 9 days	Mean % bushes infected	Clones	Mean blisters per bush per 9 days	Mean % bushes infected
425	0.2	6.4	15	1.9	31.0
742	0.2	5.0	206	1.9	13.3
20	0.3	17.5	346	1.9	11.7
26	0.3	6.6	37	2.1	63.8
235	0.3	7.5	34	2.2	24.3
170	0.4	7.4	46	2.5	29.5
740	0.4	15.0	839	2.5	30.4
1128	0.5	8.3	1456	2.5	7.7
997	0.6	8.6	18	2.6	35.0
33	0.7	11.7	142	2.6	23.0
407	0.7	18.2	13	2.7	32.0
708	0.7	7.9	777	2.7	27.7
1054	0.7	9.3	510	2.8	40.0
384	0.8	13.6	862	2.8	35.0
397	0.8	21.8	19	3.1	30.0
928	0.8	18.9	343	3.1	45.5
1000	0.8	7.8	1005	3.1	40.0
1016	0.8	21.9	16	3.2	31.7
1001	0.8	13.3	293	3.2	31.3
1446	0.8	9.7	777	3.2	39.6
32	1.0	15.0	934	3.3	32.0
128	1.0	20.0	1530	3.3	30.0
603	1.0	15.5	331	3.5	41.3
1526	1.0	21.0	Seedlings	3.7	35.9
43	1.1	19.6	Seedlings	3.8	31.5
1526	1.1	20.5	23	3.8	36.7
105	1.2	32.5	331	3.9	27.7
1016	1.2	21.7	45	4.2	37.8
1076	1.2	19.2	1530	4.2	38.0
1	1.3	33.6	22	4.3	40.9
4	1.3	24.5	1118	4.4	14.0
396	1.4	27.0	216	6.2	31.3
960	1.4	40.0	14	6.4	38.3
9	1.5	25.8	1114	8.4	62.0
687	1.5	18.8	222	8.5	31.7
1387	1.5	15.8	216	9.4	44.1
999	1.6	31.4	1082	11.3	49.5
21	1.7	23.8	Seedlings	11.6	47.2
43	1.7	22.5	25	15.1	58.3
483	1.7	27.5	1294	30.0	83.2
—	—	—	1294	30.6	87.5

Note.—These data have not been corrected for the greater liability to infection resulting from high yield, and high-yielding clones therefore occupy a lower position in the table than would have been the case if this had been done.

#### 4. FELLING SHADE TREES

As a result of the arrival of blister blight in Ceylon, policy as regards permanent shade has been revised on many estates with a view to increasing the proportion of bush green manures and of those types of tree shade whose density can be easily controlled by lopping

Where felling of grevilleas, etc., is undertaken, anxiety is sometimes expressed as to the risk of infection of the stumps by root disease fungi. The risk can only be avoided in those cases where it arises from the spread of existing root disease patches, by the normal process of excavation and destruction of all diseased material.

Where risk is anticipated from infection of the stump by airborne spores, neither ringing in advance nor treatment with chemicals like Sodium arsenite can be regarded as a sufficient protection in the present state of our knowledge. It is usually best to effect a compromise between the risk of infection and the cost of avoiding it. By felling the trees just below the collar, extra expense is incurred in cutting a shallow trench round the tree and in axefelling through the thickest part of the tree. But the exposed surface can be covered over with soil immediately and left to invasion and destruction by the saprophytic fungi present in the soil. Such a method provides a reasonable degree of protection against airborne infection by root disease fungi, without involving heavy expense in stump extraction.

#### 5. CUTTING-ACROSS

The importance has been emphasised elsewhere in this number of removing all soft banji regularly during the initial five or six plucking rounds of fields recovering from cutting-across just above the tipping level ("Travancore or Skiff" pruning). Attention is again drawn to the subject here in view of its importance. Fields should be plucked off very early, to one leaf.

Some confusion has arisen as the result of the use of the term 'skiffing' in the Interim Note, reprinted elsewhere in this number. It was intended to emphasise that the cut-across was higher than one at the normal pruning level, and did not adhere exactly, in steep fields, to the level half-an-inch above the previous tipping level that is usually understood by a "Travancore" prune. It would, perhaps, have been better if the term "Travancore" had been used.

#### 6. THE LOW CUT-ACROSS

The following data refer to yields obtained from plots either clean pruned, or cut-across at the same level as the clean prune. Comparisons were repeated in January, April and September to obtain a fair cross-section of the pruning effect under different seasonal conditions. The plots were tipped at 4½ inches. In view of the recommendation to tip (or pluck off) fields at a very much earlier stage of recovery than was the custom at the time these results were obtained, the weights of tipping material removed have been included in the first year yields.

Total yield of plots (lbs.)	Clean Prune	Cut-Across at same level	Cut-Across yield as percentage of clean prune yield
By end of 1st year	1198	1345	112.3
By end of 2nd year	2610	2665	102.1
By end of 3rd year	3573	3549	99.3
By end of 4th year	4310	4223	98.0

There is thus evidence that though the distribution of yield during the cycle may be altered by the type of pruning, the final difference in yield over a four-year cycle is so small as to be of very doubtful importance.

#### 7. ALTERNATIVE HOSTS

The possibility of *Exobasidium vexans* occurring on an alternative host to the tea bush was of considerable interest at one time, but the question has become one of academic importance only since the fungus has demonstrated its capacity to persist throughout the year on tea in Ceylon.

A very large number of specimens of jungle trees, weeds and garden plants have been received at the Institute for examination, and thanks are due to all those who assisted in this way. In no case was the blister blight fungus found to be responsible for the "blistered" appearance of such specimens.

A careful watch has been kept on the plants in an incomplete collection of *Ternstroemiaceae*, to which family the tea bush belongs, at St. Coombs. Even though blisters have been extremely frequent on tea in the vicinity, no blisters have been found on the following related species: — *Camellia japonica*, (Various garden types), *C. sasanqua*, *C. rosaeiflora*, *C. forrestii*, *C. reticulata*, *C. maliflora*, *C. cuspidata*, *C. oleifera*, *Cordia imbricata* and *Saurauja nepalensis*.

The wild hill rhododendron, *R. arboreum*, has long been known as the host of *Exobasidium rhododendri* Cran. and of *E. zeylanicum* Petch. Leaves of this tree bearing blisters were received from Bandara-wela. The blisters and characteristics of the fungus corresponded to the description

of *E. rhododendri* and cross-inoculation on to tea failed. Garden azaleas on St. Coombs have remained unaffected.

To sum up, no evidence of the presence of an alternative host for *E. vexans* in Ceylon has been obtained.

#### 8. THE INFLUENCE OF MANURING ON THE INCIDENCE OF BLISTER BLIGHT

The view that a more 'vigorous' or more 'healthy' tea bush should be more resistant to the attacks of a fungal disease dies hard. If by "health," some form of resistance is implied, there can be little argument, but if the meaning intended is more nearly related to that of 'vigour,' the conception is ill-founded.

In certain crops in temperate countries rapid growth may result in seedlings maturing beyond the vulnerable stage before conditions become favourable to the pest or fungus to which they are liable. In tea, where cropping is continuous, this means of evasion can only be utilized in the specialised case of recovery from pruning. In bearing tea, high cropping or "vigour" is accompanied by an inevitable increase in the proportion of young shoots and 'third leaves' upon the bush, and therefore by an increase in the susceptible area of the bush. Heavy flushing is likely, therefore, to be accompanied by increased blister blight when conditions are favourable to the disease.

This has been found to be the case on the clonal plots at St. Coombs and on the manurial plots at Passara.

The effect of manuring on the incidence of blister blight has been examined at Passara over a period of six months, and recording was commenced at St. Coombs

as soon as the local incidence of blister blight was heavy enough to justify it. The data collected provide an effective example of that co-operation between departments of the Tea Research Institute on the subject of blister blight over which anxiety has occasionally been expressed in quarters not able to maintain direct touch with the work. The data were collected by staff of the Entomological section on the Manurial plots run for the past twelve years at Passara by the Agricultural Chemistry section and analysed by the staff of the Physiological and Mycological sections.

#### 9. TIME OF PRUNING IN DISTRICTS RECEIVING BOTH MONSOONS

As has been frequently pointed out, the decision as to the extent to which field programmes are modified to meet in advance the risks of crop loss from blister blight must be made locally in the light of the relative losses anticipated from blister blight and from such modification. There is, however, no question that ordinary prudence demands that pruning be timed in such a way as to reduce loss of crop in the first year to the minimum. This can only be achieved by ensuring as far as possible that fully formed plucking tables, complete with shoots in all stages of development, have been formed before the onset of the South West Monsoon. In the *average* year, in districts receiving both monsoons, such recovery from pruning will proceed most normally if 'budbreak' occurs in mid-January and the tipping shoots have late January, February, March and perhaps April in which to develop relatively unchecked by blister blight.

Extensive field observations on fields pruned late in 1946 and early in 1947 have led to the following preliminary conclusions which should be used as the basis of the 1947-48 "dry weather recovery" programme at elevations above 1,500 feet.

- (a) Where the period between pruning and budbreak is approximately six weeks, as at 4,500 feet in Dimbula, pruning should be completed *before the end of January*.
- (b) Where budbreak takes a longer or shorter period, pruning should be completed proportionately before or after the end of January respectively. Thus in the Nuwara Eliya district, where recovery is slow, the programme should be completed earlier.
- (c) The earliest advisable date for pruning in Dimbula, considering blister blight only, is about 1st December, which would result in the earliest pruned fields reaching budbreak about mid-January. At higher elevations the first advisable date would be earlier.
- (d) Since completion of the annual programme, even after the obvious step of considerably enlarging the pruning gang has been taken, between 1st December and the end of January may be impossible, some additional risks may have to be taken as a matter of necessity. These extra risks are least if pruning is started earlier than 1st December and greatest when carried on later than the end of January. The former allows of later recovery in the dry weather even if damage *does* occur in January from infections taking place in December or early January. But the latter may result, as we have now good reason to know, in fields being out of production for the greater part of the year if the tipping shoots are severely damaged during the pre-monsoon rains.

(e) Where, in spite of the above advice, it is decided for local reasons to prune as late as February, the pruning should be very much lighter, in order to encourage more rapid recovery than normal. The pruning before the end of January may be normal, *with these provisos:*

- (i) Maintain spread by leaving all fringe branches intact to the future tipping level.
- (ii) Leave numerous, *closely spaced*, points of last cycle, wood. The pruned bush should present a *table* of 'points' and not resemble an empty saucer. Points should not be more than 4 inches apart if possible.
- (iii) Avoid cutting down into old wood as far as possible.

#### 10. RESISTANT BUSHES.

In those areas of tea pruned in April, 1947 or later, damage has been generally severe at the higher elevations. Very

giving concrete evidence of such abnormally high resistance should allow the Institute a supply of material for propagation if possible, since it is particularly desirable that such cases should be thoroughly investigated. The policy of avoiding wet weather recovery has been so generally followed that the area of pruned tea sufficiently badly damaged by blister blight to show up such very isolated specimens is fortunately much smaller than would be desirable from the point of view of selecting clones resistant to the disease during wet weather recovery from pruning alone!

The interest of the data from these plots is heightened by the length of time over which differential manuring has been carried on, some twelve years. Those interested in the details of the experimental treatment should consult the annual reports of the Agricultural Chemistry section for past years.

It is sufficient to state here that the treatments under comparison over this period have been:—

	I	II	III	IV	V	VI	VII	VIII
Nitrogen	—	40	—	40	—	40	—	40
Phosphate	—	—	30	30	—	—	30	30
Potash	—	—	—	—	20	20	20	20

(Pounds per acre)

occasionally, an individual bush is found to have recovered normally, when all other bushes over large acreages have suffered severely. Usually, this is found to be a bush that was not pruned at the same time as the rest of the field. Where the bush *was* pruned at the same time and in the same way, there is a strong suggestion of very high resistance to blister blight. One such bush has been found in Ceylon so far, and two were seen in South India. It is requested that any one having a bush

The total number of blistered leaves collected from the plots over the period of nearly six months between 16th January, 1947, when they were first plucked, and the 30th June, 1947, amounted to 1,630,700. The analysis of the data showed that treatment had exercised an entirely insignificant effect upon the number of blistered leaves. (The value of  $z$  for treatment is 0.0198 as against the value of 0.4894 required to indicate a probability of 20 : 1 that a real effect exists).

Whatever results may be obtained as a result of more prolonged examination of the question, it is safe to say that additional manure offers no hope of an effective control of the disease. Its value will be in encouraging additional growth to compensate for losses sustained when blister blight is prevalent.

Since dry weight, yield is a fairly accurate measure of the number of shoots harvested, given a consistent plucking system, it also provides a measure of the number of third leaves left on the bush. The correlation between dry weight yield and blister number over the period was therefore examined. The values of  $r$  obtained were positive and varied between 0.63 and 0.81,

indicating an association between the two of between forty and sixty-five per cent of that possible. This is as large as can be expected, in view of the very large number of external factors, unconsidered here, which influence the local distribution of blister blight even in a tipping field where the greater part of the growth on the bushes is in a susceptible stage.

The possible influence of manuring which may become apparent when this relationship between crop and blister incidence is taken into account requires further examination but it can be accepted that it is likely to be of very minor practical importance in the control of the disease.

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