THE TREATMENT OF PORIA ROOT DISEASE OF TEA.

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It will be admitted that the methods adopted in the past for the eradication of certain root diseases, particularly that caused by the fungus *Poria hypolateritia* commonly known as Poria, have not been markedly successful. There is as much Poria root disease on tea estates today as there was 15 or 20 years ago, and few estates can claim to have eradicated the disease. This state of affairs is not due to indifference on the part of estate superintendents nor to the disease being of such a type that eradication is impossible. The fault lies in the method of control which has been adopted.

The method used in the past may be briefly described as follows:—

1. *The Construction of Isolation Trenches.*—I place this operation first, as trenches have come to be regarded as the most important part of the treatment, although at best, trenches are but a second line of defence and that a passive one.

2. *The Removal of Dead and Obviously Dying Bushes.*—By an "obviously" dying bush is meant one which looks very sickly as judged above ground. Any bush which is severely attacked by root disease is dying, yet for one or two years after becoming infected, it may not show any sign above ground that anything is amiss, and consequently the bush may erroneously be judged healthy. The general practice in the past has been to remove obviously dying bushes only.

The prevalence of Poria root disease on St. Coombs has afforded an opportunity for its closer study than has been possible previously, and it is now possible to indicate where past treatment has been faulty and to suggest an improved method of control. In view of past advisory work and a few lectures to Planters' Associations I realise that much that I may say this morning will not be news to many of you. Yet at the risk of repetition, and of flogging a dead horse, I decided to take as my subject this morning "The Treatment of Poria Root Disease" as I consider the matter to be of sufficient importance to warrant discussion at this conference.

With the aid of sketch plans of a few of the Poria patches on St. Coombs I hope to be able to demonstrate why the treatment in the past has not been successful, and to indicate the direction in which control measures can be improved.

Our first patch (Fig. I) is a small one. It was first located in February, 1935, when bush No. 22 was observed to be dead. Alongside was a young tea plant, marked S in the figure and there was

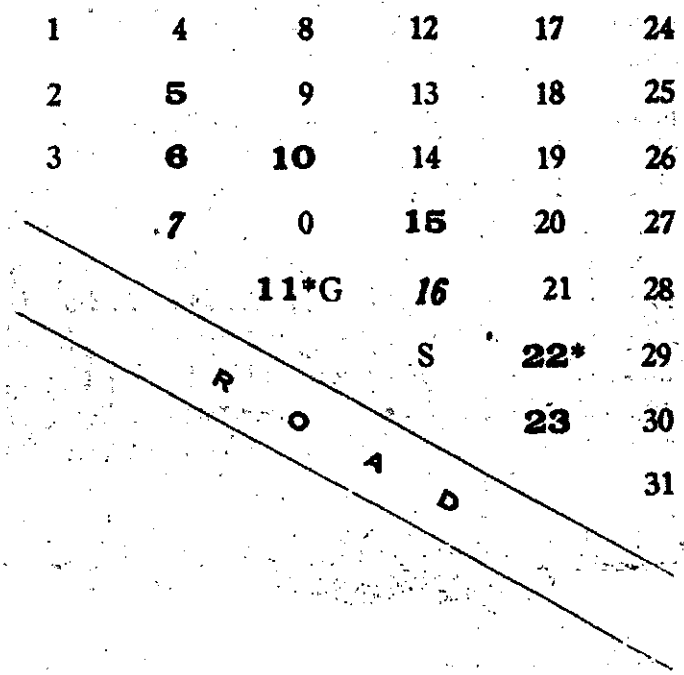

Figure I.—Bushes are represented by numerals and vacancies by 0. Diseased bushes and vacancies containing the root systems of tea bushes are shown in heavy type, and bushes which on removal were found to be healthy by italics. S indicates a supply and G a grevillea stump.

a vacancy between 7 and 15, so there were grounds for suspicion that the patch was not brand new. From an early case such as this we may be able to arrive at some conclusion concerning its original source of infection. As the patch adjoins the roadside and is quite near other older Poria patches the possibility of a dropped disease root as a source of infection must be considered. There was also a grevillea stump in the patch (marked G in the plan) to which some suspicion must be attached.

Bush No. 22 was uprooted but no contact was made with the root system of the grevillea stump. We had a look at some of the upper laterals of bushes 21 and 23 but as they appeared healthy the bushes were left. At this stage we decided to await what would happen next. The only bush removed in February was No. 22.

In October of the same year, No. 11 looked very sickly so it was uprooted together with the grevillea stump and No. 16. No. 16 proved to be healthy and we could find no trace of Poria on the grevillea stump. The evidence is therefore against the disease having originated at the stump.

At the same time we attempted to ascertain to what extent the disease had spread. The fungus was found on the roots of Nos. 5, 6, 10, 15 and 23. The infection on No. 5 was very slight, on one or two laterals, but the others had the fungus well established on their taproots. None of them gave any indication of being anything but healthy as viewed above ground. Bush No. 23 had been passed as healthy in February, but as a few of the upper laterals only had been examined it is very probable, judging from later experience, that had we gone deeper the fungus would have been found on the lower roots. The severity of its infection also indicated the unlikelihood that infection had occurred since February.

Since October, 1935, we have seen no evidence of any further disease in this plot but it is too early yet to be sure that the disease has been eradicated. The question naturally arises as to whether we have passed as healthy, bushes which were slightly affected. Time alone will show that. The removal of 7 diseased bushes of which two only looked sickly must, however, exercise a greater check on the spread of the disease than if the two sickly bushes only had been removed.

Our next patch (Fig. II) is situated in another field and is obviously also not of long standing. When located in August, 1936, there were but two vacancies and a dead bush No. 16. This patch is also on the roadside but there is no tree stump to complicate the question of source of infection. The presence of young patches on roadsides — and St. Coombs has a surprising number of them — can be explained by the dropping of diseased roots when bushes

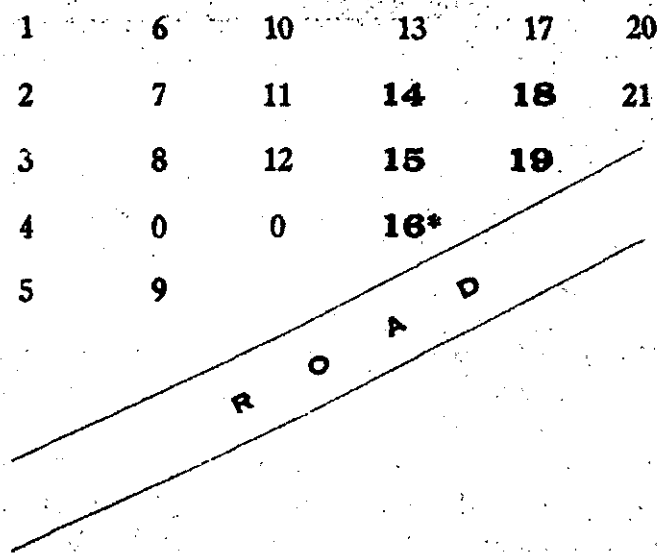

Figure II.—Bushes are represented by numerals and vacancies by 0. Diseased bushes and vacancies containing the root systems of tea bushes are shown in heavy type, and bushes which on removal were found to be healthy by italics.

have been removed for destruction. It may be advisable to emphasise the fact that Poria infected roots are highly infectious and great care has to be exercised to prevent them being dispersed in the healthy tea. Diseased bushes should always be carried in closed sacks.

In this patch we were able, by root examination, to locate 4 apparently healthy bushes with infected roots. Bushes Nos. 15 and 19 had severe infections involving the taproot, and Nos. 14 and 18 had infected laterals on the side towards 15 and 19 respectively. In this case the ratio of diseased bushes which showed no symptoms above ground to dead bushes was 4:1.

Our next patch, (Fig. III), is one in which the disease has progressed very rapidly during the last 3 or 4 years and illustrates the way in which the disease spreads outwards from the orginal centre of infection. It also affords an illustration of what I would call "piecemeal treatment."

In 1933 there were 32 vacancies and we removed 8 diseased bushes. In 1934, 11 bushes were removed; in 1935, 13, and in 1936, 7. In all 38 diseased bushes and one healthy one have been taken from the perimeter of this small patch since 1932. That number may appear exceptionally large but it must be understood that this number represents diseased bushes, not dead ones. No records were kept in 1933 and 1934 of the condition of the diseased bushes, but in 1935 of the 13 removed only one was dead and the others appeared healthy. Similarly in 1936 only 1 of the 7 removed was dead.

In 1933 and 1934 root examination was limited to what might be termed "a scratching round the collar," so we may conclude that the bushes removed in these years were in an advanced stage of attack. In 1935 we instituted a more thorough examination of bushes adjacent to those uprooted owing to disease. We also forked through the bare area to ascertain whether any old diseased tea stumps existed in the area. One only was found, that was in the row next to bush 21.

The hole made by excavating this stump was used as a starting point for root examination of adjacent bushes. By drawing back the earth from the roots of bush No. 35 it is possible to examine some of its laterals without damaging them. Similarly the roots of No. 21 could be examined from the same hole. Both bushes were found to be diseased and were uprooted. Their removal resulted in two more holes from which examination could be carried on. From the site of No. 35 bushes 20 and 34 were examined but both appeared healthy and so the work in this direction petered out. From the other hole (No. 21) we found the disease on No. 22 thence on No. 23 when again the work received a check as the bushes 8 and 24 which could be examined from this hole were healthy.

1	16	31	44	54	62	68	76	90	104
2	17	32	45	35 **55**	34 **63**	69	77	91	105
3	18	33	36 **46**	34 **56**	33 **64**	0	34 **78**	92	106
4	19	34	47	33 **57**	0	0	35 **79**	93	107
5	20	35 **35**	0	0	0	34 **70**	80	94	108
6	35 **21**	35 **0**	0	0	0	71	81	95	109
7	35 **22**	0	0	0	0	0	34 **82**	36 **96**	110
8	35 **23**	33 **36**	0	0	0	0	34 **83**	0	111
9	24	34 **37**	0	0	0	0	0	34 **97**	112
10	25	33 **38**	33 **48**	0	0	0	34 **84**	98	113
11	26	35 **39***	35 **49**	0	0	33 **72**	34 **85**	35 **99**	114
12	27	33 **40**	35 ***50***	35 **58**	0	0	36 **86**	36 **100***	115
13	28	41	51	35 **59**	33 **65**	34 **73**	36 **87**	36 **101**	116
14	29	42	52	60	35 **66**	36 **74**	88	102	117
15	30	43	53	61	67	75	89	103	118

Figure III.—Bushes are represented by numerals and vacancies by 0. Diseased bushes and vacancies containing the root systems of tea bushes are shown in heavy type, and bushes which on removal were found to be healthy by italics. The year of removal is indicated in small type.

The dead bush No. 39, however, provided another starting point and this led to the removal of Nos. 49, 50, 58, 59 and 66. No. 50 was a poor bush with a much rotted frame but its roots were found to be free of Poria.

Our objects in this plot were:—

1. To avoid removal of any healthy bush.
2. To cut down costs of root examination to a minimum by avoiding special excavation for this work.

The disadvantages of this piecemeal method of treatment are fairly obvious.

1. The work is spread over a number of years. We had to visit this plot each year from 1933 to 1936 inclusive.
2. Fairly accurate records of work done have to be kept. A plan such as we have used this morning is necessary.
3. There is a good deal of uncertainty as to when the plot can be said to be free of disease.

Concerning the last point you will see from the plan that bush No. 100 died in 1936 although it had been passed in 1935 as healthy. You will realise that in 1935 only the roots running towards the hole of No. 99 were seen. In all probability although it died before bush 86, infection occurred from that direction, *i.e.*, from a side which was not examined in 1935.

It will be realised that this area even today cannot be certified as free of disease although it will be admitted that the removal of bushes in an early stage of infection must have done much to reduce the amount of disease existing there.

This piecemeal method is not one which will recommend itself to many estate superintendents. The reduction of costs and the saving of a few healthy tea bushes are no doubt laudable objects but in the treatment of this disease they can be sources of false economy.

So far I have said nothing of isolation trenches so I may interpolate a few words here. If trenches had been cut in 1933 around the Poria patch shown in Fig. III, and sited so that there were two rows of apparently healthy bushes between existing vacancies and the trench, practically the whole of the area shown in the plan would have been enclosed. The line of bushes 15, 30, ... 103, 118 is the only line which could have been excluded. Isolation

trenches can of course do nothing towards the active eradication of the fungus. At best they can prevent the fungus from passing out of the enclosed area. Consequently, if a trench had been constructed and only dead bushes had been removed from this patch we may rightly expect from what we have seen of the spread of the disease that all the bushes within the enclosed area would become infected and die during the next ten or twenty years. During that time the trenches would have to be maintained in perfect order and the replanting of the bare area must be delayed. If these facts are accepted it becomes evident that a more economical procedure would be to remove these bushes at once and replant.

A case can be stated for the construction of isolation trenches if the piecemeal method of treatment is adopted. Even then emphasis must be laid on the removal of bushes in the early stage of infection in an attempt to prevent the fungus ever reaching the trench. Isolation trenches should never be regarded as anything more than a second line of defence which is all they were ever intended to be. Experience has proved that on our hillsides they are very inefficient and in my opinion can safely be abandoned if we are prepared to make a determined attack on the fungus by removing every bush on which it has become established.

Fig. IV is a plan of a Poria patch from which we have good reason to believe that the disease has been eradicated. This area is situated on the edge of a ravine in which infected bushes have been burnt in the past. In August, 1935 a dead bush (No. 13) and 2 sickly bushes (Nos. 43 and 48) were observed. There were apparently 11 vacancies but a diseased tea stump was found in each. Actually no tea bush had been uprooted from this area. The stumps and obviously diseased bushes 13, 43 and 48 were dug out, and the uprooting of bushes on the perimeter was carried on until every diseased bush and a complete ring of healthy bushes were removed. In all 11 stumps, 17 diseased bushes and 28 healthy bushes were dug out.

The number of healthy bushes removed may appear relatively large, but by taking them out we are certain that no diseased bush has been left in the area. Although I do not attach much importance to it, you will note that the bushes which are left are separated from the diseased soil by a belt from which healthy bushes only have been removed. Had isolation trenches been constructed the number of bushes enclosed would have been greater than the number of bushes

removed, and so our total loss is really less than if the old method of removing dead bushes and constructing isolation trenches had been adopted.

The number of healthy bushes to be removed from a patch can be reduced somewhat under close supervision and when the disease gang is thoroughly trained. On uprooting a tea bush, it will often be found that the disease occurs on one side only, that nearest the disease area. Where the laterals running towards healthy tea are themselves healthy there is no very cogent reason why the next adjacent healthy bush should be taken out. Where the work has to be left largely to the gang the apparent sacrifice of a few healthy bushes will prove economical in the end.

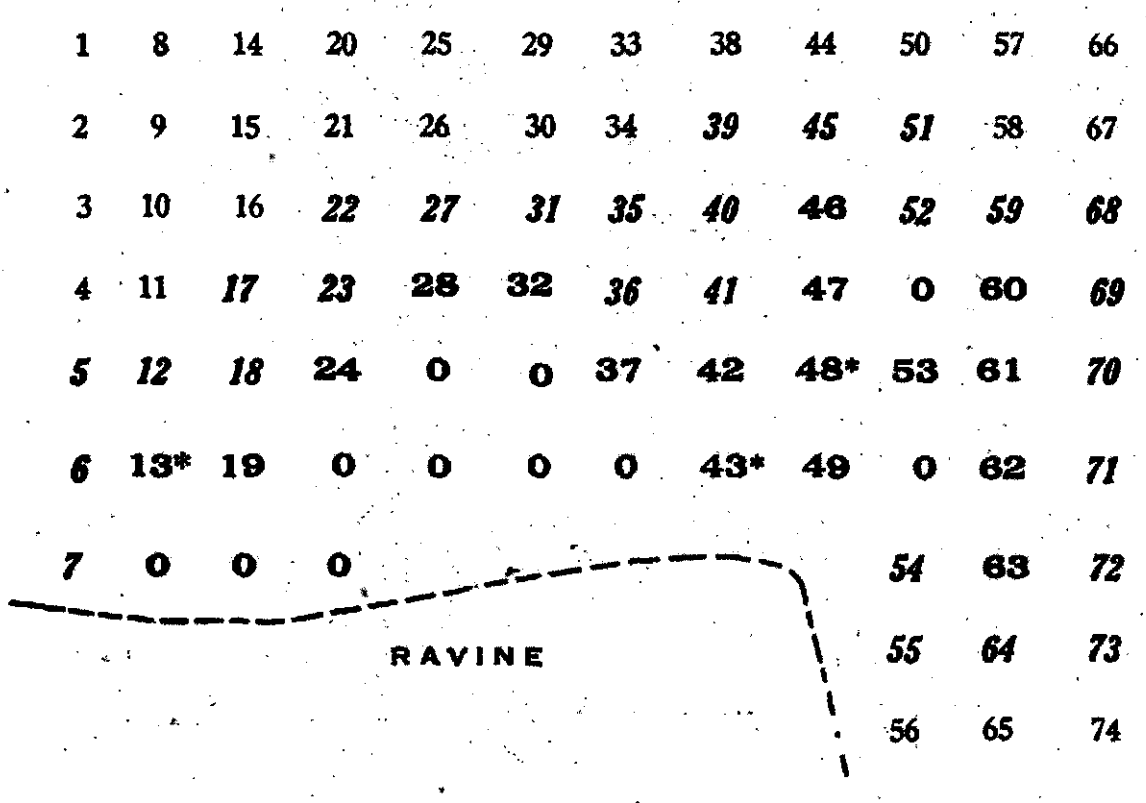

Figure IV.—Bushes are represented by numerals and vacancies by 0. Diseased bushes and vacancies containing the root systems of tea bushes are shown in heavy type, and bushes which on removal were found to be healthy by italics.

The area shown in Fig. IV was planted with *Tephrosia vogelii* after uprooting was completed. In June, 1936 a few Tephrosia plants in the area between the site of bush 37 and the vacancy below it were found to be dead with Poria on their roots. These were uprooted and a search made for the infecting material. This was found to be a few tea roots, about pencil thickness which had been overlooked in the clean-up.

This plot will be planted with tea next year and I feel confident that we shall experience no further trouble with the Poria root disease in this area.

The basis of the treatment I have here described is the removal of every diseased bush. The majority of these usually appear healthy above ground, so to ensure that none is missed a ring of healthy bushes should be removed as well. The soil must be cleared of all roots and woody material on which the fungus might live. Soil, even though the fungus is present in it, is harmless if woody material is not present. I have as yet been unable to cause infection of Tephrosia or tea with soil shaken off diseased bushes. But a diseased root readily causes infection.

Care must be taken to prevent the dispersal of diseased roots amongst healthy tea and where such material has to be carried for destruction by fire the transport should be done in closed sacks.

I feel that I cannot conclude this paper without associating with it the name of Mr. C. A. Loos, my laboratory assistant. Mr. Loos has personally supervised the uprooting of all bushes, and has been responsible for the recording of field data and the construction of plans. I have here referred to 4 plots only whereas on St. Coombs we already have 114 under observation, the records of which are as exact as those I have selected for illustration. Without this data I would not express as confidently as I do today the view that Poria as a root disease can be completely eradicated from our tea fields.