REVIEW OF THIRTY YEARS STUDY OF TEA DISEASES IN CEYLON

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Introduction

Although the main function of a research worker is to look ahead and plan experiments for the future, it is good to look back now and again, to see what has been achieved in the past and what practical conclusions have resulted from the research carried out. Repetition can thus be avoided and promising lines of work that have been started and then dropped can be picked up again. Research on a subject such as agriculture has necessarily to be productive of practical result, but frequently this entails a fundamental study of the problem to provide the basis for arriving at practical conclusions.

Literature

Before T. Petch started research on the diseases of tea in Ceylon, Watt and Mann had written a book in 1903 on the "Pests and Blights of the Tea Plant" in India, in which a dozen diseases are described. Later, most of the root, stem and leaf diseases of tea in Ceylon were described by Petch in 1923 in his book "The Diseases of the Tea Bush." Petch worked in the Department of Agriculture as Mycologist from about 1907 to 1926 and was the first Director of the Tea Research Institute of Ceylon (1926–1928). Sixty diseases of tea were described in his book.

Since the work of Petch, the number of new tea diseases investigated has been relatively small. The major achievements were in the fields of physiological disorders, eelworm diseases and virus diseases. In Monograph No. 2 of the Institute on 'The Commoner Diseases of Tea' written by the first Mycologist of the Institute, C. H. Gadd, in 1948, we find about 20 important diseases described.

Review

When we review the Annual Reports of the Tea Research Institute since 1926, it is interesting to note how the emphasis on particular problems has changed in the course of the years.

In 1926 Gadd considered the Cercosporella leafspot disease as most important. There is no doubt that as Acacias, which are also susceptible to this fungus, were more numerous as shade trees then, the tea was more severely infected with it than nowadays. A second problem studied was that of chlorosis. Gadd discerned different types and identified at least one cause for the condition when he found that the sap of chlorotic leaves was much less acid (pH about 6.0) than that of healthy leaves. He concluded that the kind of chlorosis under consideration was due to too high a soil pH. This led him in 1927 to conduct experiments on the water culture of tea seedlings, whereby he established the importance of the pH of the medium for the good growth of tea.

The prevalence of *Poria* root disease was recognised from early times and research on methods of control started. As far back as 1930 the advice for the control of Poria root disease was the uprooting of a ring of healthy bushes around the diseased ones. In 1936 work on this disease was crowned with the conclusion drawn from pot experiments with *Tephrosia vogelii* that, if soil is completely freed from roots infected with Poria, it is not infectious any more.

This was one of the main subjects of investigation of the Pathology Division from 1927 till 1939; thereafter phloem necrosis and eelworms became the more important lines of study. *Armillaria* root disease was first mentioned in 1927, but fortunately it never became as important here as in East Africa.

The importance of the amount of food reserves in the root system in connection with recovery from pruning was recognised about this period. For instance, the incidence of dieback, until then attributed to *Diplodia* root rot at mid and low elevations, was instead linked with lack of food reserves.

In 1926 Gadd had mentioned the occurrence of a kind of witches broom in tea. This condition became an important subject of research in the years 1930–33. Gadd tried to relate it to the symptoms of sulphur deficiency or yellows of tea in East Africa, but abandoned the idea when he found that sulphur-containing fertilizers had no influence on the incidence of witches broom. It was, however, not established at what depths the intake of nutrients and water mainly occur during the period of witches broom growth and how deep the sulphur-containing fertilizer penetrated during the period of observation. The question of the relation of this condition with yellows of tea remains therefore unsettled. Experiments on transmission were also unsuccessful. The cause of the disease remains unknown even today. It would appear that the incidence of witches broom in tea has diminished since 1933. It may be that a change in fertilizer practice has led to higher soil acidities and thereby to a decrease of the disease.

In 1936 phloem necrosis virus disease was mentioned for the first time as a serious and spreading disease on up-country estates above 4000 ft. Its cause remained unknown till 1939. Gadd suggested 'curly leaf' as its popular name. This suggestion could not be adopted however, as it was found that many bushes reveal necrosis in the bark without showing any outward symptoms.

In 1936 also polyclady was described. It might be of interest to note the symptoms of this condition in detail. They are:

1. prolific production of small whippy branches from the ground,
2. leaves small and hard,
3. branches wiry and close together—hardly a main frame,
4. roots turn upwards and give rise to numerous branches,
5. a large number of shoots stay below soil level and occur as white, spirally curled stems.

Judging from the symptoms, the disease might be caused by a virus.

1937 is marked by the first mention of eelworms in tea (root-knot eelworm). Research on the subject continued and in 1939 the much more important meadow eelworm was discovered in old tea.

On the work on phloem necrosis during the intervening period, the hypothesis that a virus was the cause was enunciated in addresses given by Gadd to Planters' Association meetings up-country. He disclosed during one discussion that a transmission experiment by inarching had given definite proof that phloem necrosis was caused by a virus. Gadd suggested the appointment of a specialist for this subject, and from 1940–1944 T. E. T. Bond studied the problem intensively. Summarising Bond's studies we can draw the following conclusions:—

1. Numerous transmissions of the virus by grafting gave definite proof of the virus nature of this disease.
2. The spread of the virus in the plant is slower than the elongation of a fast-growing shoot.
3. The necrosis persists in new growth from necrotic cuttings.
4. In a field on St. Coombs a 10% increase of diseased bushes was found during one year.
5. Rogueing is a possible method of controlling the spread of phloem necrosis.
6. A diseased scion can be grown on a healthy seedling-rootstock, without this rootstock starting to show symptoms, due to the tolerance of this seedling-rootstock towards the virus (symptomless carrier).
7. No proof of seed transmission is available and no insect vector has been found.
8. High jat material can act as a symptomless carrier for the virus.
9. Its occurrence in the field discloses both a discontinuous spread and a bush-to-bush spread.

In August, 1945, with the departure of Bond research on phloem necrosis ceased.

Mycological work in 1940 led to the discovery of *Pleiochaeta albizziae* (Petch) Hughes as the cause of a serious leaf disease of Albizzia seedlings in the nursery, and of the presence locally of the fungus related to tea scab *Elsinoe theae*, as identified by South American research workers.

In the years 1941–1946 the study of nematodes in tea was one of the main lines of work done by Gadd and Loos.

In 1946 blister blight made its first appearance in Ceylon. In the years following the whole of the activities of the Pathology Division was concentrated on this major problem. In 1947 it was known that cuprous oxide could be used for the control of this disease, but it was doubted whether it would be economic to spray the whole tea crop as a preventive measure. In 1948 the study of the life history of blister blight was continued and in 1949 the first spraying experiments against blister blight were started.

During the first blister blight Symposium in 1949 the control measures advocated were summarised by G. B. Portsmouth and C. A. Loos. Spraying was only advised for pre-tipping fields and nurseries. The other control measures suggested were changes in cultural practices and the selection of resistant clones. In 1950 the problem of controlling blister blight became very urgent and the Shell Company decided to send its pathologist at the Amsterdam laboratory to the Institute to study control measures during the south-west monsoon. As a result of his studies, copper emerged as the most suitable of the fungicides for the purpose.

In 1950 a second blister blight Conference was held and the idea of "crop protection" was introduced. This meant that instead of only protecting pruned fields and nurseries the whole crop had to be sprayed. Many experiments were done by Loos and B. N. Webster in 1950 and 1951 on spraying regularly throughout the monsoon with a fungicide and by 1952 spraying with copper compounds was general practice on almost all up-country tea estates.

When it had been found that the spraying of copper was effective and economic, numerous other fungicides and spraying, dusting and mist blowing techniques were tried out, partly with the help of commercial firms. It was shown however that copper fungicides were ideal for the purpose because the low quantity

of copper used does not affect the colour or the flavour of the tea and has a favourable effect on fermentation. During severe monsoon conditions, spraying provided the only definite answer to the problem of blister blight control, dusting being a good alternative under more favourable weather conditions.

The first stage in the studies on the control of this disease was concluded in 1955 with the publication of a pamphlet on the "Protection of Ceylon Tea from Blister Blight" by Portsmouth and Webster.

The initial advice of spraying pruned fields and nurseries only, has been extended to the recommendation of spraying the whole estate regularly from two plucking rounds before the onset of the monsoon to the end of the rainy season.

In 1955 a revival of eelworm research took place; the search for resistant clones was started under the direction of Loos who became the first eelworm specialist in the Institute. When he left his work was continued by T. Visser, who became acting Pathologist in 1957 on the departure of Webster. In regard to findings on this subject, it has been shown that soil disinfection with eelworm-destroying chemicals (nematocides) is too expensive for large scale work in the field, but that it can be carried out in the nursery. A new possibility was put forward by Visser when he showed that the marigold (*Tagetes* sp.) has the capacity of killing eelworms through one of its root excretion products.

1957 was the last year of the testing of commercial fungicides for blister blight control by the Institute. The latest development in the control of this disease took place in 1958 when it was shown that sunshine is the most important factor for the inhibition of spore germination. Experiments on a method of forecasting blister blight on the basis of sunshine records were then started.

Major achievements

When we review the major achievements of the Institute in connection with the diseases of tea we may summarise them as follows:—

1. Parasitic root and leaf diseases were studied intensively before the establishment of the Institute, but control measures as for instance against Poria were worked out by the Institute.
2. Witches broom was studied for a number of years, but the cause remained unknown, although some circumstances stimulating its development were revealed.
3. The blister blight disease was studied intensively and efficient measures of control were developed; costs remain high, however. A new method of timing the spraying based on sunshine records may enable the industry to economise on this item.
4. The problem of meadow eelworm has been studied for a long time but the final solution has not yet been found, although the prospects for the use of cover crops like marigold appear hopeful. Selection of clones for resistance gives good results. A method for the fumigation of nurseries was worked out.
5. The phloem necrosis virus disease was identified in 1939 and studied for five years thereafter. In 1945 the work was discontinued. Research was resumed in 1958.
6. Dieback and wood-rot have been studied since 1926 until now and a number of weak parasites related to these troubles have been described. No definite method of control has, however, been found as this trouble is not a pathological problem but the result of bad cultural practices in the past and of shot-hole-borer attack.