# INFECTION CHAINS AND ACACIAS

B. N. Webster.

*It is hoped that this note may serve as an introduction to the following paper by Dr. Gorrie, and that it may explain why the Tea Research Institute is anxious to collect as much information as possible on the species of Acacia at present growing on, or near, tea estates. A brief description of infection chains, and their importance to the plant pathologist, is followed by an explanation of the part played by certain species of Acacia in the infection chain of the so-called " Cercosporella " disease of tea.*

An infection chain has been described as " the serial transmission of infective material from host to host ". This chain may be either interrupted, or continuous, depending upon whether the pathogen is able to pass part of its life cycle separated from its hosts, or must, of necessity, pass directly to fresh host material. Examples of the latter type of chain are commonly met with in human diseases, where either direct contact, or " droplet " infection occurs. The pathogens concerned form neither resting stages nor spores, and are unable to exist saprophytically, *i.e.*, on non-living material. In plant diseases this type of infection is the exception rather than the rule, being met with only in the viroses and certain bacterioses such as the bacterial canker of stone fruits. It may be argued that the blister blight fungus, and other similar fungi, have such a transient existence as spores, which do not, as far as is known, possess powers of resistance, that they should be included in this category.

The great majority of plant pathogens, however, belong to the group having interrupted or discontinuous infection chains and are able to exist through long periods on dead roots remaining in the ground etc. Many of these form, during their period of saprophytic existence, resting bodies, such as the sclerotia of the species of *Corticium* causing black rot and of *Sclerotium rolfsii* the common nursery fungus. Others form resistant spores during certain stages of their life cycle, and the 'perfect' spore forms of the Rosellinia and Ustulina root disease fungi, with their relatively thick walls, provide an example. These spores are able to exist for fairly long periods until suitable conditions of environment bring about their germination and reinfection of suitable material.

The links of an infection chain are the various hosts of the pathogen, and the weak links in the chain provide the answer to control. It is thus of great importance to the pathologist that he should gain a thorough knowledge of the whole chain in order to find the weakest link on which to concentrate his attack.

The major category of discontinuous chains may be further subdivided into two more divisions, that of homogeneous chains and heterogeneous chains. In the former, the pathogen is limited to one host species, or group of species, whilst in the latter the pathogen possesses more than one, often many, hosts, and in addition may be able to exist saprophytically. The significance of these two chain types is that in the first, the links of the chain are well defined, and any weak links are fairly obvious, whilst in the second there is a possibility that links formed between the parasitic and saprophtic stages of existence, and vice versa, may be obscure.

To take a well known example of the first type, the blister blight fungus, *Exobasidium vexans*, is host specific to tea, and the weak link in its infection chain is furnished by the short-lived, susceptible spores. It is impossible to eradicate the fungus once established, except by removal of infected leaves, so control must be directed to the transmission stage. It can be effected in several ways, principal amongst which are the destruction of the spores on germination by prophylactics applied to the host, and the removal of susceptible host material by hard plucking.

Examples of heterogeneous infection chains are furnished by the majority of the fungi commonly causing diseases of tea. Few ever assume epidemic proportions, and the principal method of control comprises the removal and destruction of infected material, coupled with the removal of susceptible material, for example the clearing of leaf litter during an outbreak of the Rosellinia disease. Examples of chains with fairly obvious weak links, in diseases which occasionally assume local epidemic proportions, are afforded by the brown blight fungus, *Colletotrichum camelliae*, and the Poria root disease fungus, *P. hypolateritia*. In each instance control is achieved by denying host material to the pathogen. In the first, where the pathogen is unable to effect direct entry into the tea leaf by endeavouring to prevent leaf damage, typically caused by sunscorch, and in the second by removing a ring of healthy tea bushes from around the locus of infection, in addition to the removal of infective material.

The so-called " Cercosporella " disease of tea, caused by the fungus *Calonectria theae* Loos, falls into this category of diseases having heterogenous infection chains. It is not host specific, having a wide range of hosts, including Acacia species. Albizzia sp., Eucalyptus sp., Tephrosia sp., etc., whilst in addition it is able to survive as a saprophyte on Acacia and tea leaf litter. Its full host range is not completely known, and attempts are now being made at the Tea Research Institute to extend our knowledge of its hosts, both as a parasite and as a saprophyte. It is not well adapted as an active parasite of tea, spore infections being limited to the very young flush, but it is however, an active parasite of *Acacia decurrens*, which suffers severe defoliation. The infected leaflets of the Acacia fall onto the underlying tea, and the actively growing fungus is able to penetrate the mature tea leaves and considerable damage follows.

The saprophytic stages in the life history of this fungus are followed in the litter of fallen Acacia and tea leaves on the ground. The conditions of high humidity met with under a cover of tea are ideal for the development of the fungus, and two types of spores are produced, representing two phases in the life cycle of the fungus (as distinct from the infection cycle). The so-called imperfect spores are produced in large quantities and may infect any of the hosts mentioned above, as well as continuing the saprophytic existence. The perfect spores, resulting from a possible sexual process, are produced within closed fruiting bodies and constitute a possible resting stage in the life cycle.

The significance of *Acacia decurrens* in the infection chain of *Calonectria theae* is that it constitutes the means whereby severe infection of the tea results. Thus it forms a weak link, in that it is removable. To what extent this disease can develop in the absence of Acacias is not known but there have recently been a number of reports of apparently severe flush infection although the fungus has not actually been recoverable from the flush, in areas where no Acacias are growing. It has, therefore, been argued, that if such infection can indeed occur, there seems little point in not growing Acacias, particularly as, in some of the areas where the disease is most prevalent, Acacias constitute the only low shade and wind break trees that it is possible to grow.

To revert to the consideration of weak links, and points for attack referred to above, it must be emphasised that practical control measures must be economically feasible. Little is known of the susceptibility of this fungus to prophylactic sprays, but it is known that copper spraying directed primarily against blister blight does not protect tea from *Calonectria theae*, ("Cercosporella".) Any copper spray of greater concentration than this would be uneconomical. Removal of Acacias, or rather the avoidance of Acacias is economical, but shade is necessary, so the possibility of growing Acacias and yet removing susceptible material must be accomplished. Accordingly, trials are to be made of growing Acacias, and lopping them frequently during wet and misty weather, when the disease is prevalent. Whether the loppings must be removed or not will depend on the severity of spore infections building up as a result of fungus growth on the litter.

The use of resistant materials must also be considered, and infectivity trials are being made on a number of the species referred to in Dr. Gorrie's key. Not all are available, however, and so we should welcome information on any of the species which may be identified, particularly as to their suitability for growing above 5,000 feet.