DISEASES OF TEA, COFFEE AND RUBBER DISCUSSED AT THE FIRST INTERNATIONAL CONGRESS OF PLANT PATHOLOGY

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THE First International Congress of Plant Pathology was held from 14th to 26th July 1968, at the Imperial College of Science and Technology, London and was attended by over 1,200 delegates from all over the world. The following is a brief account of the papers presented on plantation crops, particularly Tea, Coffee and Rubber which may be of some use to research workers of these plantation crops in India.

TEA

Dr. Kerr and Dr. de Silva of the Tea Research Institute of Ceylon presented a paper on the Blister Blight of tea. According to them, Blister Blight was first recorded in Ceylon, in 1946 and it spread subsequently to all planting districts, causing serious damage to the tea, particularly during active monsoon at altitudes of 1500 feet and above. The disease is spread by wind-borne spores, which show a marked diurnal fluctuation in number, the spore release being dependent on high atmospheric humidity.

Disease incidence in Ceylon is rated by the 3rd leaf method, and significant damage occurs when the infection rate is over 35%. The disease is controlled by 7 to 10 day rounds of copper fungicide sprays, during monsoon periods and it is estimated that 30 to 35 rounds per year are not uncommon. But theoretically, as few as four rounds may be adequate in some years. Two major factors increase the disease incidence, *viz.*, the number of spores landing on susceptible leaves and the duration of the leaf wetness. The former is directly correlated with the number of spores in the atmosphere and can be predicted if the current level of infection and mean daily sunshine during incubation and sporulation are known. Daily sunshine is negatively correlated with the leaf wetness and is more convenient to use for disease forecasting and predicting. By judiciously combining sunshine records with measured or estimated spore numbers, disease incidence can be accurately predicted. Disease forecasting cannot cover extensive areas in Ceylon because of variable climatic conditions over relatively short distances. Because of this, a simple calculating device was discovered to enable individual estates to forecast disease incidence. The utility of these methods for forecasting disease under South Indian and North-East Indian conditions need be investigated.

Dr. C. S. Venkataram of the UPASI Tea Experimental Station dealt with the developments in spraying technique and the control of Blister Blight. A large number of fungicides have been screened but with the exception of Daconil, no organic fungicides or antibiotics controlled Blister Blight effectively at economic rates of usage, because of poor tenacity. Fungicides are generally sprayed as water suspensions or solutions on tea. Oil as a carrier is not generally recommended due to the problems involved in tainting. Dusting has its limitations. The frequent heavy showers wash away the dust making dusting less effective than spraying. Until 1960, only protectant copper fungicides were in vogue. In South India, the trend is gradually shifting from protective copper spraying to the use of nickel chloride, which is claimed by Dr. C. S. Venkataram to be an eradicant.

The use of nickel, according to him, has the added advantage of exerting very little influence on the build-up of mite pest in tea, whereas copper is reported by UPASI research workers to stimulate the population of mites, especially the purple mite and the red spider. As nickel is supposed to have a systemic action, it is not fully known what happens to the nickel which goes into the plant system. As nickel is washed away from the surface of the plants by rain, its fate in the soil is also quite obscure at this stage. The search for a fungicide with systemic action against Blister Blight has not been fully rewarding. Soil treatment with nickel salts and derivatives of oxathiin resulted in systemic disease control of potted tea plants, but proved impractical on a field scale. On the other hand, systemic control of Blister Blight on young plants was achieved with a foliar spraying of oxathiin under laboratory conditions, but in the field similar treatment was found not effective.

Dr. Shanmughan Nathan of the Tea Research Institute of Ceylon presented a paper on the parasitism and control of the tea root disease fungi. Root diseases are quite serious on tea plantations in Ceylon. As in South India, the most serious one is Red root rot caused by *Poria hypolateritia.* Besides the above, Charcoal Stump rot (*Ustulina deusta*), Brown root rot (*Fomes noxius*) and Black root rot (*Rosellinia arcuata*) also occur. Red root rot disease alone has destroyed over 1000 acres of tea in the country and continues to spread both in the old and new plantings. Heretofore, these diseases have been controlled by laborious and expensive digging and removal of infected roots and subsequent replanting. The efficacy of these practices vary. The recent discovery that soil fumigation with methyl bromide at ½ lb for every 100 sq. feet is very effective in eradicating these pathogens, promises a great improvement in root disease control. Other benefits like, vigorous growth of tea following fumigation, have been reported.

Poria hypolateritia does not produce viable air-borne spores in Ceylon and only known sources of inoculum are the infected roots of tea or the shade trees, only a small amount of which is said to infect young tea plants. In South India the fructifications of the fungus have been noticed on tea. It would be of interest to see whether they occur on the jungle vegetation also. It is regrettable that very little work on the basidiomycetes has been done in this part of our country. It is observed that the pathogen (*P. hypolateritia*) can survive for long periods in infected root tissues and still retain its infectivity. Infection generally occurs by root contact and by growth of mycelium through the soil. Colonization of root system is confined to the top 30" in soil.

Ustulina deusta spreads mainly by air-borne spores produced on infected shade tree stumps. Ring barking of shade trees has proved to be a useful means of reducing disease outbreaks by reducing stump infections.*

Coffee

Drs. Nutman, Griffiths and Vine have discussed the Coffee Berry Disease in East Africa, which is now widespread in Kenya. There can be few, if any, areas where Coffee Berry Disease does not occur. In 1967, losses in some plantations amounted to not less than 80 to 90% and loss for the country as a whole has been estimated at about 30%. The reason for considerable increase in the severity is largely climatic according to them. There was much heavier than average rainfall in 1967 and it was more uniformly distributed throughout the year. The fungus *Colletotrichum coffeanum* produces its spores on the bark at the onset of the rains.

Both spore production and infection can be significantly reduced by application of fungicide before the rain, but with the present rainfall pattern, secondary spread from spore production of infected berries leads to rapid build-up of disease in the period after the rains. The situation is aggravated by the widespread occurrence of multiple flowering (running blossom). Young developing crop as well as ripening berries from a previous flowering may co-exist on the tree. When such a situation arises together with favourable conditions for spread and infection, ripe berries which are very susceptible become infected producing large number of spores and this may lead to heavy loss in the crop.

Effective control now seems to demand a break in the cycle of overlapping crops and reinforcement of the pre-rain sprays (designed to reduce the spore load on the bark) with protectant spray in the period after the rains. With the result, fungicides for the control of Coffee Berry Disease should ideally eliminate or reduce spore production from infected bark, provide adequate protection to the developing berries, be effective in controlling the leaf disease caused by *Hemileia vastatrix.* It will be interesting to note the great similarity in the spraying schedule of the Coffee Berry Disease and the leaf disease.

Coffee berries take about 9 months to mature and for most of this time, they are highly susceptible to infection. Spores are water-borne and infection occurs most frequently during the rainy season. Spraying at these times with tractor-mounted equipment is often extremely difficult and hence the fungicide with high biological persistence and resistance to weathering is required. Captafol (Difolotan) seems to be one of the most useful of the commercially available fungicides and used for extensive field trials. Laboratory methods for evaluating fungicides in the control of Coffee Berry Disease have been developed which

* Investigations in North-East India have revealed that *Ustulina* in most instances infects through unhealed wounds.

show good correlation with field performance. Using these methods a large number of products have been screened, a few appear particularly promising. As a result of Coffee Berry Disease becoming increasingly serious pre-long-rains spraying will have to be supplemented by post-rains spraying and Captafol [N-(1, 1, 2, 2-Tetra Chloro ethyl thio) Cyclohex-4-ene-1, 2-dicarboximide] is considered to be highly suitable for such a programme.†

RUBBER

Drs. Wastie and Chee of the Rubber Research Institute, Kuala Lumpur, dealt with problems on the chemical control of diseases of *Hevea* rubber in Malaysia. Formerly the chemical control of diseases of rubber in Malaysia was largely confined to mouldy rot (*Ceratocystis fimbriata*) on the tapping panel and *Pellicularia salmonicolor* (Pink disease) on branches. However, 20 years of extensive planting in mono-clone blocks of high-yielding selections has been followed by an increase in the severity of the diseases above ground. In a re-appraisal of control techniques of *P. salmonicolor*, it was stated that Bordeaux mixture, though effective, cannot be used on tapping cuts because of the danger of copper contamination of latex. Moreover, the fungicide has got to be applied at frequent intervals. A more tenacious formulation based on paranitrophenol seems to have overcome this disadvantage. Leaf fall caused by *Oidium* and *Colletotrichum glœosporioides* severely affects the growth of certain clones. Sulphur dusting against *Oidium* has increased yield and vigour of a highly susceptible clone. Control of *Colletotrichum* remains an intractable problem, largely because of physical difficulty of obtaining good coverge of fungicide on the foliage of mature trees. The seedling leaf disease caused by *Helminthosporium heveæ*, the effects of which have become very significant as a result of changing budding techniques, has effectively been controlled by carbamate fungicides particularly Zineb and Maneb. Outbreaks of *Phytophthora* leaf fall in the last two years have necessitated the exploration of control techniques. Tapping panel infection by the same pathogen can be controlled with tin or mercury based fungicides, but high mammalian toxicity seems to pose problems.

The developments in the last few years of the fungicidal dressing as a prophylactic treatment against root disease, has filled a long-standing gap. The active ingredient (Quintozene) is highly active against the principal root pathogens (*Fomes lignosus*) but not against *Ganoderma pseudoferreum* though there is a promise that a formulation effective against both these fungicides will be found ultimately.

Dr. Chee reported variability in *Phytophthora* isolates from rubber in Malaysia. Morphological and physiological studies, spore size, spore production, pairing characteristics, cardinal temperatures for growth, colony development on solid nutrient substrata have been made with more than 250 *Phytophthora* isolates causing disease on rubber in Malaysia and Thailand. Differences in morphology and pathogenicity of the isolates are considerable. Their classification into species and strains was attempted. Rubber, cocoa, and an atypical strain of *P. palmivora* are recognised. They show the greatest variation among or within the strains. Most isolates from leaves, pods and twigs are more uniform and resemble *P. meadii*, but differ in having exceptionally smaller sized sporangia. All but few isolates from the leaves, pods and twigs, comprising strains of both species in culture, produce sporangia in great abundance and in clumps conspicuously visible to the naked eye when grown in light illumination. Black stripe of the tapping panel and patch canker of untapped bark are associated with less freely sporing strains of *P. palmivora* throughout W. Malaysia, but in areas affected by leaf fall, black stripe may be caused by the other species. The distribution of strains follows a geographic pattern, anomalous or non-complementary strains are found in areas where both complementary strains co-exist.

† In the light of Coffee Berry Disease occurring in East Africa, the New Malady of Coffee in South India was discussed with the East African workers and while the question of pathogen particularly *Colletotrichum* being involved has not been over-ruled, Drs. Nutman and Griffiths have suggested that further work should be carried out, particularly on the saprophytic and parasitic strains of *Colletotrichum* of coffee occurring in South India. The rapid sporulation of several fungi including *Colletotrichum* following the first rains in March-April reveal a striking similarity to the Coffee Berry Disease. The fact that thorough spraying on coffee ameliorates the New Malady of coffee in South India to a certain extent, leaves one to doubt whether the condition is only purely physiological.

It is essential to investigate the role of several strains of *Colletotrichum* which begin sporulating immediately after first showers on the setting of the berries. Dr. Nutman is of the opinion that the strains of *Colletotrichum* which produce the *Glomerella cingulata* stage may be purely saprophytic and pathogenicity trials should be largely concentrated on the imperfect strains of the fungus.

Dr. O. S. Peres of Vidyodaya University, Ceylon, discussed the economics of control of *Fomes lignosus* in Ceylon. According to him, *Fomes lignosus*, being a weak parasite, must have a food base from which it will spread to infect the healthy tree. Expenditure on the eradication of food bases prior to replanting has been found to be economically sound. An analysis of labour requirements for disease control and the growth of young rubber after treatment for *Fomes* control has proved that the periodical examination of the root system of every tree, for infection though practical, is uneconomical.

Treatment on the basis of leaf symptoms, that is, at an advanced stage of infection is feasible. The use of fungicides for control of the disease is not warranted in both cases. The use of prophylactic methods which prevent reinfection of treated trees and those adjacent to them, is justifiable.

Addition of small quantities of sulphur to the soil at the time of planting, lowers the soil reaction, encourages growth of saprophytic *Trichoderma viride* and reduces incidence of *Fomes* infection. For economic reasons, this treatment should be confined to areas which are known to be heavily infected with *Fomes* prior to replanting. It is concluded that the most economical method of controlling *Fomes* at present is to plant at a slightly higher density than that required at the time of maturity and to eradicate *Fomes* infected trees as a part of routine thinning out operations. Transplanting should be done only to prevent too uneven a stand. Sulphur can be added to the soil profitably at the time of planting in areas known to be heavily infected.

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SOLUTE-VACANCY INTERACTION IN ALUMINIUM-ZINC-SILVER ALLOYS

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ABSTRACT

Electrical resistivity measurements have been used to follow the isothermal ageing of Al–4·4% Zn, Al–4·4% Zn–0·03% Ag and Al–4·4% Zn–0·08% Ag alloys. Vacancy-Silver atom-binding energy has been evaluated as 0·15 eV at 0° C.

INTRODUCTION

INTERACTION between the two types of defects—solute atoms and vacancies—in metals has been the subject of study in recent years. These interactions are of great importance in evaluating the mechanism of atom transport in age hardening alloys, particularly aluminium base alloys. Although the influencing parameters are many, attempts have been made to discuss the ageing process in terms of an interaction between the supersaturated thermal vacancies and solute atoms. It is now widely accepted that in the decomposition process following the quench vacancy-type defects play a very dominant role. Study of this type of interaction gives rise to the concept of a binding energy, E_B^{v-i} between the vacancy and the solute atom.[1] The different energy terms that contribute to the binding energy have been discussed in detail.[2] Some theoretical estimates are available, but E_B^{v-i} for a number of solutes in Al matrix have been determined experimentally by several workers,[3–11] and different methods of evaluating this term have been discussed.[2] Since the electrical resistivity of a metallic specimen is sensitive to the nature and distribution of point defects, the best estimate of this interaction energy is made by following the changes in electrical resistivity immediately after the quench.

On going through the literature we found that there existed a considerable discrepancy in the reported values of binding energy for different elements in Al matrix. In trying to read order into these values (E_B^{v-Me} in Al) Perry[11] suggested certain convincing refinements in experimental procedure and analysis of results. In the absence of a well-developed theory to explain the exact physical significance of the binding energy, it becomes necessary to evaluate this term for different metals by separate experiments. Also it is said[12] that any explanation put forward on the basis of