UNIVERSITI PUTRA MALAYSIA

SOME ASPECTS OF THE BIOLOGY AND CHEMICALLY ASSISTED BIOLOGICAL CONTROL OF GANODERMA SPECIES IN MALAYSIA

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By

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The biology of *Ganoderma* parasitic to oil palm and rubber was investigated. The main aspects studied were the morphology of sporophores and basidiospores, and pure culture studies of the isolates with a view to compare their cultural and growth characteristics under different temperatures and hydrogen-ion concentrations of the medium. *Ganoderma* isolates of oil palm originating from three different locations namely Kedah, Perak and Selangor in Malaysia exhibited some variations although all belonged to one species, *Ganoderma miniatocinctum* Stey. Comparisons of oil palm isolates with a confirmed isolate of *Ganoderma philippii* (Bres. & P. Henn.) Bres. from *Hevea* rubber revealed that the rubber fungus differed distinctly from oil palm fungal isolates.

Control measures currently followed based on sanitation, eradication and prophylactic chemical measure against Ganoderma infection of rubber have become increasingly cost intensive. Therefore an alternative approach of chemically assisted biological control was investigated. Introduction of an antagonistic component of soil microflora, T. harzianum, into the rubber rhizosphere with and without supplementation with organic matter (dried cow manure) and the application of selected fungicides, tridemorph, drazoxolon, etridiazole and sulphur, at minimal rate were evaluated in a field experiment conducted in a five-year old rubber stand affected by Ganoderma root disease at Sungai Gapi Estate, Serendah, Selangor. The results obtained demonstrated that each of the above treatments individually enhanced the soil mycoflora population in the rubber rhizosphere and more specifically the population of antagonistic genera belonging to Trichoderma, Penicillium and Aspergillus. The population levels of soil mycoflora and the above mentioned genera in particular monitored monthly for a period of seven months revealed the following results:

Within the combination treatments, a three way combination consisting of inoculation with T. harzianum + soil application of fungicide, drazoxolon + supplementation with cow manure produced the highest enhancement of soil mycoflora in general

and specifically Trichoderma, Penicillium and Aspergillus which were monitored individually. Among two-way combinations, Trichoderma + cow manure gave the second highest increase of rhizosphere mycoflora. Inoculation of T. harzianum + cow manure + sulphur gave the third highest increase. The other combinations also gave varying degrees of enhancement effects. With regard to the recovery of infected trees in the treatments, application of chemicals drazoxolon and sulphur respectively gave the highest response. During a seven months' observation period in the field, the enhancement of general rhizosphere mycoflora and Trichoderma spp. in particular recorded by monthly sampling, demostrated that the increase in their population levels had been maintained until four months following the treatment and decreased gradually there on. Among the antagonistic genera studied, Trichoderma gave the highest increase in population levels when compared to those of Aspergillus and Penicillium.

In view of the positive response of the above treatments on rhizosphere mycoflora and specifically on the antagonistic fungal flora populations and their demonstrated inhibition of Ganoderma infections in the experimental site, it can be concluded that chemically assisted biological control offers scope as a practical control measure. However, cost

effectiveness and relative ease of implementation of these methods compared to existing control practices needs to be further evaluated.

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BEBERAPA ASPEK BIOLOGI DAN KAWALAN BIOLOGI
BERBANTU KIMIA SPESIS GANODERMA
DI MALAYSIA

Oleh

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Biologi kulat Ganoderma parasit terhadap tanaman kelapa sawit dan getah telah diselidiki. Antara aspek-aspek yang dikaji ialah morfologi sporofor dan basidiospora, cara mendapatkan kultur tulen asingan Ganoderma dan bandingan ciri-ciri kultur dan pertumbuhan mereka di atas media yang berlainan suhu serta kepekatan ions hidrogen yang terpilih. Asingan-asingan Ganoderma dari Kedah, Perak dan Selangor mempamirkan beberapa variasi sungguhpun tiap-tiap satu berasal dari spesis yang sama, Ganoderma miniatocinctum Stey. Terdapat perbezaan ketara dari asingan kelapa sawit ini dengan asingan getah, Ganoderma philippii (Bres.& P. Henn.) Bres.

Kawalan masakini bagi mengatasi jangkitan penyakit akar Ganoderma menyerangi tanaman getah berasaskan sanitasi, eradikasi dan kimia profailatik, tetapi ianya didapati bertambah mahal.

Oleh yang demikian, pilihan lain untuk kawalan telah diselidiki melalui cara biologi berbantukan kimia. Penyelidikan bertempat di Ladang Getah Sungai Gapi, Serendah, Selangor yang melibatkan gabungan penggunaan kulat antagonis (Trichoderma harzianum), bahan organan (najis kering lembu) dan kadar minimum empat racun kulat terpilih (tridemorph, drazoxolon, etridiazole dan sulfur) ke bahagian rhizosfera getah berumur lima tahun serta dijangkiti penyakit akar Ganoderma. Keputusan menunjukkan tiap-tiap rawatan memberi peningkatan populasi mikroflora tanah terutama dari genera Trichoderma, Penicillium dan Aspergillus. Tahap peningkatan populasi apabila dikesan tiap-tiap bulan selama tujuh bulan berturut-turut, memberi gambaran berikut:

Antara rawatan gabungan, kombinasi tiga hala yang mengandungi penginokulatan T. harzianum, aplikasi racun kulat drazoxolon dan tambahan bahan organan, memberi peningkatan tertinggi populasi mikroflora tanah khususnya genera-genera Trichoderma, Penicillium dan Aspergillus. Kombinasi dua hala dengan penggunaan T.harzianum bersama bahan organan menghasilkan tahap kedua peningkatan populasi mikroflora berkaitan. Peningkatan populasi di tahap ketiga diperolehi dari kombinasi T. harzianum, bahan organan dan sulfur. Gabungan rawatan-rawatan lain juga memberi berbagai tahap kesan peningkatan populasi. Dalam rawatan untuk memulihkan pokok-pokok yang

dijangkiti, penggunaan bahan kimia drazoxolon dan sulfur masing-masing memberi respon yang tertinggi. Pemerhatian selama tujuh bulan di ladang melalui persampelan bulanan, peningkatan populasi mikroflora amnya dan khusus bagi genera Trichoderma, berlaku hingga keempat bulan dan kemudiannya menurun. Di antara genera kulat antagonis yang dikaji selepas rawatan, Trichoderma mendapat peningkatan populasi yang tertinggi jika dibandingkan dengan Penicillium atau Aspergillus.

Memandangkan respon positif dari rawatan ke atas mikro-flora rhizosfera terutamanya populasi kulat antagonis yang berupaya memberi kerencatan jangkitan Ganoderma, kesimpulan diambil bahawa kawalan biologi berbantu kimia mempunyai masa depan yang cerah untuk dipraktikkan. Walau bagaimanapun, keberkesanan dan kemudahan meimplementasinya berbanding dengan cara kawalan masa kini, perlu diberi kajian yang mendalam sebelum ianya dapat dipraktikkan dengan meluas di ladang.

CHAPTER 1

INTRODUCTION

Malaysia has primarily an agricultural based economy with a well developed plantation crop agriculture. Most important among the plantation crops are rubber and oil palm. Up to date, Malaysia is the largest producer of rubber and palm oil in the world. Presently *Hevea* rubber has a planted area of about two million hectares and oil palm nearly one and a half million hectares (Anon, 1986). A third plantation crop which is currently expanding in Malaysia is cocoa (*Theobroma cacao* L.). From only 500 ha in 1960 the area under cocoa has increased to nearly 300,000 ha in 1986 (Anon, 1986). Malaysia has become the fourth largest producer of cocoa in the world. When compared to rubber, oil palm and cocoa, tea occupies a much smaller area of just over 2,000 ha. Although the hectarage is small the crop is important as it provides the most part of the local tea consumed.

Due to the extensive monospecies stand of plantation crops, ravages by pests such as root diseases become problematic. Root diseases caused by wood-decay basidiomycetes are major pathological problems of plantation crops in Malaysia (Varghese *et al.*, 1975). They kill trees directly, irrespective of their age and vigour (RRIM, 1974). The root disease pathogens spread insidously undetected underground and

occur on most soil types and terrain in varying frequency (Lim, personal communication, 1983). Ganoderma species are major root pathogens of rubber, oil palm, cocoa and tea plantings in Malaysia. With regard to speciation, the pathogens of rubber, cocoa and tea belongs to Ganoderma philippii (Bres. & P. Henn.) Bres (previously identified as G. pseudoferruem). The red root disease of rubber caused by G. philippii is one of the major root diseases of rubber (RRIM, 1957). The red root disease caused by Ganoderma is recorded to be the commonest and destructive root disease of tea in Malaysia (Thompson, 1939; Mc.Intosch, 1951). However, those species which attack oil palm are not the same. Although, initially, identified as G. lucidum it is now known that this species does not occur in the Tropics. So the speciation of Ganoderma attacking oil palm is not entirely clear, although according to Steyaert (1967) there appears to be many species involved.

The severity of attack has been well documented by several workers. For instance heavy losses were observed in both young and old palm due to basal stem rot caused by Ganoderma spp. reaching to about 50% by the fifteenth year (Turner and Bull, 1967). The disease was especially high in areas replanted from coconuts and oil palms and in coastal plantations (Turner, 1965a).

Ganoderma is a host inhabitant root pathogen and exists in the soil mainly in colonised host tissue (Varghese, 1972).

Diseased residual stumps and roots in the soil therefore can serve as inoculum sources. Usually a large inoculum potential is indicated in efficiently transmiting the disease to healthy plants. Hence, the removal of diseased material from cultivated soil by clean clearing has remained the most efficient method of control of the disease in the above mentioned plantation crops even though the procedure has become increasingly cost intensive. So far chemical control of Ganoderma has had little success , even though some residual fungicides incorporated in a collar protectant formulation are used widely against Ganoderma infection of Hevea rubber.

Biological control is another approach which has been attempted against root diseases from as early as 1920 (Cook and Baker, 1983). Risbeth (1963) had successfully prevented Heterobasidion annosum infection of pine stumps by inoculation of Peniophora gigantea to freshly cut stumps. Recent studies on biological control of basidiomycetous root pathogens of plantation crops have indicated that Trichoderma spp. are antagonistic to such pathogens in the soil (Varghese et al., 1975; Sivan et al., 1983; Basuki, 1985; Peries and Liyanage, 1985). In a recent approach to biological control of Ganoderma of tea and oil palm, Varghese, Chew and Lim (1975) found that enhancement of antagonistic mycoflora against Ganoderma spp. could be manipulated by fumigation with methyl bromide in combination with mulching and fertilizer (NPK) application which resulted in faster inactivation of Ganoderma in infected tea stands.