



UNIVERSITI PUTRA MALAYSIA

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

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

By

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TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENTS	iii
LIST OF TABLES	viii
LIST OF FIGURES	xi
LIST OF PLATES	xiv
ABSTRACT	xvi
ABSTRAK	xx
 CHAPTER	
1 INTRODUCTION	1
2 LITERATURE REVIEW	5
Root Diseases of Plantation Crops Caused by <u>Ganoderma</u> spp.	5
Economic Importance of <u>Ganoderma</u> Root Disease	7
Symptoms of <u>Ganoderma</u> Diseases	9
Taxonomy and Morphology	11
Effects of Environmental Factors on Growth of the Fungus	13
Epidemiology	14
Initiation and Development of the Disease	14
Spread of the Disease	17
Control of <u>Ganoderma</u>	20



CHAPTER		PAGE
	Development of Red Root Disease Control in Malaysia and Elsewhere	24
	Biological Control of Root Pathogens and Its Reference to <u>Ganoderma</u>	25
3	THE BIOLOGY OF <u>GANODERMA</u>	31
	Introduction	31
	Materials and Methods	32
	Morphology of Basidiocarps and Basidiospores	32
	Cultural Studies	37
	Results	42
	Morphology of Basidiocarps and Basidiospores	42
4	CHEMICALLY ASSISTED BIOLOGICAL CONTROL OF <u>GANODERMA</u> SPECIES	73
	Introduction	73
	Materials and Methods	73
	Morphological Studies on Selected Genera of Soil Rhizosphere Mycoflora of Rubber	73
	<u>In Vitro</u> Assessment on Antagonism of Mycoflora	76
	Field Experiment: Chemically Assisted Biological Control	77



CHAPTER	PAGE
Results	84
Morphological Studies on Selected Genera of Soil Rhizosphere Mycoflora of Rubber	84
<u>In vitro</u> Assessment on Antagonism of <u>Ganoderma</u> by Selected Species of Soil Mycoflora	108
Field Experiments: Chemically Assisted Biological Control	117
Discussion	136
5 GENERAL SUMMARY AND CONCLUSION	146
REFERENCES	152
APPENDICES	
A Analysis of Variance	163
B Analysis of Cow Dung	174
C Rankit of Infection	176
D Medium for Isolation	180
VITA	181



LIST OF TABLES

TABLE		PAGE
1	Morphological Features of Basidiospores	43
2	Comparison of Mean Spore Length, Spore Breadth, Pore Diameter and Dissepiment Thickness of Four Field Isolates of <u>Ganoderma</u>	48
3	Morphological Features of Basidiocarp.....	50
4	Percentage Success in The Isolation of <u>Ganoderma</u> Using Five Isolation Methods.....	57
5	Growth Rate of Four Field Isolates of <u>Ganoderma</u> on Malt Extract Agar Seventh Day After Incubation.....	60
6	Cultural Characteristics of <u>Ganoderma</u> Isolates on MEA	60
7	Growth Rate of Four <u>Ganoderma</u> Isolates at Different pH Levels on Malt Extract Agar at Seventh Day of Incubation	62
8	Growth Rate of Four <u>Ganoderma</u> Isolates at Different Temperatures on Malt Extract Agar at Seventh Day of Incubation	64
9	Rate of Fungicide Application	81
10	Comparison in the Ability of Five <u>Trichoderma</u> Species to Cause Parasitism on Four <u>Ganoderma</u> Isolates	111
11	Comparison in the Ability of Six <u>Penicillium</u> Species to Cause Antagonistic Effect on Four <u>Ganoderma</u> Isolates	114
12	Comparison in the Ability of Five <u>Aspergillus</u> Species to Cause Antagonistic Effect on Four <u>Ganoderma</u> Isolates	116



TABLE		PAGE
13	Summary Table of Disease Rating of Red Root Disease Inoculated Healthy Trees at 90 Days After Inoculation (DAI)	118
14	Summary Table of Disease Rating of Red Root Disease Inoculated Healthy Trees at 180 Days After Inoculation (DAI)	119
15	Comparison in the Progress of Infection 90 Days After Inoculation	121
16	Comparison in The Progress of Inhibition 180 Days After Inoculation	122
17	Condition of Inoculum Pieces at 90 Days After Inoculation (DAI)	124
18	Condition of Inoculum Piece at 180 Days After Inoculation (DAI)	124
19	Recuperating Progress of Previously Infected Trees Inspected at 180 Days After Inoculations of Healthy Trees	125
20	Comparison in the Population of Soil Mycoflora Within Treatments Over a 7-Month Period at Sungai Gapi Estate, Selangor	127
21	Comparison in the Population of Mycoflora at Three Levels of Sampling in a Trial Conducted at Sungai Gapi Estate, Selangor	128
22	Comparison in the Population of <u>Trichoderma</u> Species Within Treatments Over a 7-Month Period at Gapi Estate, Selangor	129
23	Comparison in the Population of <u>Trichoderma</u> at Three Levels of Sampling in a Trial Conducted at Sungai Gapi Estate, Selangor	130
24	Comparison in the Population of <u>Penicillium</u> Species Within Treatments Over a 7-Month Period at Sungai Gapi Estate, Selangor	132



TABLE		PAGE
25	Comparison in the Population of <u>Penicillium</u> at Three Levels of Sampling in a Trial Conducted at Sungai Gapi Estate, Selangor	133
26	Comparison in the Population of <u>Aspergillus</u> Species Within Treatments Over a 7-Month Period at Sungai Gapi Estate, Selangor.....	134
27	Comparison in the Population of <u>Aspergillus</u> at Three Levels of Sampling in a Trial Conducted at Sungai Gapi Estate, Selangor	135



LIST OF FIGURES

FIGURE		PAGE
1	Map Showing Sampling Locations of Field Isolates of <u>Ganoderma</u> in Peninsular Malaysia	33
2	Schematic Drawing of Basidiocarp and Its Internal Structure	34
3	The Method of Sampling 20 Pores (after Steyard, 1967)	36
4	Camera Lucida Drawing of Basidiospores of <u>Ganoderma</u> Isolate EE-1 (Elmina Estate, Selangor)	44
5	Camera Lucida Drawing of Basidiospores of <u>Ganoderma</u> Isolate BK-1 (Batu Kawan Estate, Kedah)	45
6	Camera Lucida Drawing of Basidiospores of <u>Ganoderma</u> Isolate UP-1 (Jenderata Estate, Perak)	46
7	Camera Lucida Drawing of Basidiospores of <u>Ganoderma</u> Isolate SG-1 (Sungai Gapi, Estate, Selangor)	47
8	Camera Lucida Drawing of Cutis, Isolate EE-1	53
9	Camera Lucida Drawing of Cutis, Isolate BK-1	54
10	Camera Lucida Drawing of Cutis, Isolate UP-1	55
11	Camera Lucida Drawing of Cutis, Isolate SG-1	56
12	Growth Rate of Four <u>Ganoderma</u> Isolates at Different pH Levels on Malt Extract Agar Seventh Day of Incubation	63



FIGURE		PAGE
13	Growth Rate of Four <u>Ganoderma</u> Isolates at Different Temperatures on Malt Extract Agar Seventh Day of Incubation	65
14	Layout of Treatments in a Single Experimental Block	79
15	Camera Lucida Drawing of <u>Aspergillus</u> <u>candidus</u>	86
16	Camera Lucida Drawing of <u>Aspergillus</u> <u>giganteus</u>	88
17	Camera Lucida Drawing of <u>Aspergillus</u> <u>niger</u>	89
18	Camera Lucida Drawing of <u>Aspergillus</u> <u>sydowii</u>	91
19	Camera Lucida Drawing of <u>Aspergillus</u> <u>ustus</u>	92
20	Camera Lucida Drawing of <u>Penicillium</u> <u>duclauxii</u>	94
21	Camera Lucida Drawing of <u>Penicillium</u> <u>ochrochloron</u>	95
22	Camera Lucida Drawing of <u>Penicillium</u> <u>pinophilum</u>	96
23	Camera Lucida Drawing of <u>Penicillium</u> <u>soppii</u>	98
24	Camera Lucida Drawing of <u>Penicillium</u> <u>terrestre</u>	99
25	Camera Lucida Drawing of <u>Penicillium</u> <u>vermiculatum</u>	101
26	Camera Lucida Drawing of <u>Trichoderma</u> <u>hamatum</u>	102
27	Camera Lucida Drawing of <u>Trichoderma</u> <u>harzianum</u>	104



FIGURE		PAGE
28	Camera Lucida Drawing of <u>Trichoderma</u> <u>koningii</u>	105
29	Camera Lucida Drawing of <u>Trichoderma</u> <u>longibrachiatum</u>	107
30	Camera Lucida Drawing of <u>Trichoderma</u> <u>viride</u>	109
31	Growth Inhibition of Four <u>Ganoderma</u> Isolates by Five <u>Trichoderma</u> Species	110
32	Growth Inhibition of Four <u>Ganoderma</u> Isolates by Six <u>Penicillium</u> Species	113
33	Growth Inhibition of Four <u>Ganoderma</u> Isolates by Five <u>Aspergillus</u> Species	115



LIST OF PLATES

PLATE		PAGE
1	Infected Oil Palm Cube Maintained Within a Polythene Bag	38
2	Basidiocarps of <u>Ganoderma</u> Collected From Four Different Locations in Peninsular Malaysia	51
3	Elements of Cuticle Layer of <u>Ganoderma</u> Isolate EE-1 (x 850)	53
4	Elements of Cuticle Layer of <u>Ganoderma</u> Isolate BK-1 (x 850)	54
5	Elements of Cuticle Layer of <u>Ganoderma</u> Isolate UP-1 (x 850)	55
6	Elements of Cuticle Layer of <u>Ganoderma</u> Isolate SG-1 (x 850)	56
7	Cultural Characteristics of <u>Ganoderma</u> Isolates EE-1 (Elmina Estate) Obtained From Single Spore Isolation	58
8	Light Microscopy of <u>Aspergillus candidus</u> (x 650)	86
9	Light Microscopy of <u>Aspergillus giganteus</u> (x 100)	88
10	Light Microscopy of <u>Aspergillus niger</u> (x 650)	89
11	Light Microscopy of <u>Aspergillus sydowii</u> (x 650)	91
12	Light Microscopy of <u>Aspergillus ustus</u> (x 650)	92
13	Light microscopy of <u>Penicillium duclauxi</u> (x 650)	94



PLATE		PAGE
14	Light Microscopy of <u>Penicillium ochrocloron</u> (x 1300)	95
15	Light Microscopy of <u>Penicillium pinophilum</u> (x 650)	96
16	Light Microscopy of <u>Penicillium soppii</u> (x 650)	98
17	Light Microscopy of <u>Penicillium terrestre</u> (x 650)	99
18	Light Microscopy of <u>Penicillium vermiculatum</u> (x 650)	101
19	Light Microscopy of <u>Trichoderma hamatum</u> (x 650)	102
20	Light Microscopy of <u>Trichoderma harzianum</u> (x 650)	104
21	Light Microscopy of <u>Trichoderma koningii</u> (x 650)	105
22	Light Microscopy of <u>Trichoderma longibrachiatum</u> (x 650)	107
23	Light Microscopy of <u>Trichoderma viride</u> (x 1300)	109



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BIOLOGICAL CONTROL OF GANODERMA SPECIES
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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, demonstrated 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 mempamerkan 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 berbantuan 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 mikroflora 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 insidiously 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 transmitting 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.

