



UNIVERSITI PUTRA MALAYSIA

**ULTRASONIC CHARACTERISATION OF OIL PALM TRUNK
INFECTED BY *GANODERMA BONINENSE* DISEASE**

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BY *GANODERMA BONINENSE* DISEASE**

By

MOHD KHAIRUL NAJMIE BIN MAMAT

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfillment of Requirements for the Degree of Master of Science**

April 2011



*I dedicated this thesis to
My Parent, My Wife, My Son and Family Members
Whose prayers, support and love
Blessed my heart and sustained me in the years of life.*

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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Chairman : Professor Haji Kaida Khalid, PhD

Faculty : Science

The ultrasonic characteristics for oil palm trunk which have been infected by *Ganoderma boninense* disease has been studied by using the ultrasonic commercial equipment at frequency 54 kHz. Among the physical characteristics that identifiable in oil palm tree that infected by *Ganoderma boninense* disease was by appearance a mature *Ganoderma* basidiocarp at the stem, lower fronds of an oil palm tree were dead and fractured. An oil palm tree of 30 years old has been used in this study.

The measurement method used in this study was direct transmission method. The study of ultrasonic properties of oil palm trunk was infected with *Ganoderma boninense* disease were made in two stages; where in the first stage, measurement are made at standing oil palm tree and in the second stage; measurement was done in the cut trunk of stem centre to blocks size measuring $5 \times 10 \times 10 \text{ cm}^3$. The number of samples used is 27 and consist of 3 sections namely: inner zone, central zone and peripheral zone.

Results for standing oil palm tree showed that the ultrasonic velocity in the infected with *Ganoderma boninense* disease sample is between 350 – 600 ms⁻¹ while healthy trunk the velocity was exceeding 700 ms⁻¹.

Measurement on the sample cut found that the trunk density of the sample infected decreased as much as 50% of the healthy stem. Percentage of moisture contents the infected areas also higher than the healthy areas. This affects the ultrasonic velocity through radial direction, tangential direction, and longitudinal direction for infected by *Ganoderma boninense* disease area which was consistently lower than healthy stem area. For the 10 cm thickness samples, the ultrasonic velocity for all transit directions was in the range of 260 – 750 ms⁻¹ for the infected sample whereas for healthy samples was in the range of 460 – 900 ms⁻¹.

While, result of elasticity constant for the infected sample was between 0.2 – 8.5 (10⁸ Nm⁻²) for all directions while the healthy area which was between 1.3 – 32.1 (10⁸ Nm⁻²) for all directions. These results are very useful for the detection and identification of the location which has been affected by the disease.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PENCIRIAN ULTRASONIK BATANG KELAPA SAWIT YANG DIJANGKITI
PENYAKIT *GANODERMA BONINENSE***

Oleh

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Ciri-ciri ultrasonik untuk batang kelapa sawit yang dijangkiti oleh penyakit *Ganoderma boninense* telah dikaji dengan menggunakan alat ultrasonik komersial berfrekuensi 54 kHz. Antara ciri-ciri fizikal dikenalpasti pada pokok kelapa sawit yang dijangkiti penyakit *Ganoderma boninense* ialah dengan kemunculan basidiokarpa *Ganoderma* yang matang pada batang, manakala pelepahnya patah dan mati. Sebatang pokok kelapa sawit berusia 30 tahun telah digunakan dalam kajian ini.

Kaedah pengukuran yang digunakan dalam kajian adalah kaedah penghantaran terus. Proses pengukuran dibuat dalam dua peringkat; dimana peringkat pertama, pengukuran dibuat pada pokok yang hidup dan peringkat kedua; pengukuran pada batang kelapa sawit selepas ditebang dimana batang tersebut dipotong dalam bentuk blok bersaiz 5 ×

$10 \times 10 \text{ cm}^3$. Bilangan sampel yang digunakan sebanyak 27 sampel dan ditanda kepada tiga bahagian iaitu zon dalam, zon tengah dan zon periferi (pinggiran).

Keputusan pada pokok hidup menunjukkan halaju ultrasonik yang dijangkiti oleh penyakit *Ganoderma boninense* diantara $350 - 600 \text{ ms}^{-1}$ berbanding pokok sihat melebihi 700 ms^{-1} .

Pengukuran untuk batang selepas ditebang didapati ketumpatan batang yang dijangkiti oleh penyakit *Ganoderma boninense* berkurangan sebanyak 50% berbanding dengan batang yang sihat. Peratusan kelengasan untuk batang yang dijangkiti juga lebih tinggi berbanding batang sihat. Dari kesan ini masa transit untuk gelombang ultrasonik merambat melalui arah jejarian, arah tangen, dan arah membujur lebih tinggi untuk kawasan dijangkiti penyakit *Ganoderma boninense* berbanding kawasan batang sihat. Untuk sampel ketebalan 10 cm, halaju ultrasonik untuk semua arah ialah kira-kira $260 - 750 \text{ ms}^{-1}$ untuk batang dijangkiti oleh penyakit *Ganoderma boninense* manakala untuk sampel sihat ialah kira-kira $460 - 900 \text{ ms}^{-1}$.

Manakala keputusan pemalar kekenyalan pula menunjukkan bahawa kawasan yang dijangkiti penyakit *Ganoderma boninense* adalah di antara $0.2 - 8.5 (10^8 \text{ Nm}^{-2})$ setiap arah. Pemalar kekenyalan untuk kawasan yang sihat pula di antara $1.3 - 32.1 (10^8 \text{ Nm}^{-2})$ untuk setiap arah. Keputusan ini sangat berguna untuk pengesanan kawasan yang mana telah terjejas oleh penyakit itu.

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I certify that a Thesis Examination Committee has met on 14 April 2011 to conduct the final examination of Mohd Khairul Najmie Bin Mamat on his thesis entitled "Ultrasonic Characterisation of Oil Palm Trunk Infected by *Ganoderma Boninense* Disease" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the degree of Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

MOHD KHAIRUL NAJMIE BIN MAMAT

Date: 14 April 2011

TABLE OF CONTENTS

	Page
DEDICATION	ii
ABSTRACT	iii
ABSTRAK	v
ACKNOWLEDGEMENTS	vii
APPROVAL	vii
DECLARATION	x
LIST OF FIGURES	xv
LIST OF PLATES	xvii
LIST OF TABLES	xix
LIST OF SYMBOLS AND ABBREVIATIONS	xx
CHAPTER	
1 INTRODUCTION	1
1.1 Oil Palms Industry	1
1.2 Problem Statement	3
1.3 Objectives	6
1.4 Thesis Outline	7
2 LITERATURE REVIEW	8
2.1 Introduction	8
2.2 Oil Palm Tree	9
2.2.1 General Characteristics of Oil Palm	9
2.2.2 Anatomical Review of Oil Palm Trunk	11
2.3 Physical Characteristics of Oil Palm Tree	14
2.3.1 Moisture Content of Oil Palm Trunk	14

2.3.2	Density of Oil Palm Trunk	15
2.3.3	Mechanical Characteristics of Oil Palm Trunk	17
2.3.4	Chemical Characteristics of Oil Palm Trunk	19
2.4	<i>Ganoderma boninense</i>	20
2.4.1	Basal Stem Rot Disease	20
2.4.2	Disease Emergence	20
2.4.3	Disease Symptoms	21
2.4.4	Causative Organism	24
2.4.5	Spreading of Disease	25
2.4.6	Histopathology	25
2.4.7	Disease Controls	26
2.5	Ultrasonic Studies on Wood	27
2.6	Ultrasonic Imaging	31
3	ULTRASONIC THEORY	32
3.1	History and Application of Ultrasonic Technique	32
3.2	Advantages and Disadvantages of Ultrasonic Technique	33
3.3	Ultrasonic Wave Production	35
3.3.1	Piezoelectric Effect	35
3.4	Attenuation and Scattering	38
3.5	Piezoelectric Transducer	39
3.6	Orthotropic Nature of Wood	43
3.7	Environmental Effect	44
3.8	Basic Definitions	45
3.8.1	Transit Time	45
3.8.2	Density of Wood	46

3.8.3	Determination Method Moisture	
	Content with Wet Basis and Dry Basis	46
3.8.4	Fiber Directions	47
3.8.5	Ultrasonic Pulse Velocity	48
3.9	Wave propagation in Anisotropic Media	48
3.10	Ultrasonic Bulk Wave Propagation in Orthotropic Media	50
4	METHODOLOGY	51
4.1	Nondestructive testing (NDT) – Ultrasonic	51
4.1.1	Echo Pulse Method	51
4.1.2	Resonance Method	52
4.1.3	Pulse Transmission Method	52
4.2	Decay Detection in Tree Trunk with Ultrasonic Transmission Method	54
4.3	Instrumentation	55
4.3.1	Chainsaw	55
4.3.2	Vertical Log Saw	56
4.3.3	Radial Arm Saw	56
4.3.4	Analytical Balance	57
4.3.5	Ultrasonic Tester V-Meter Mark II	57
	4.3.5.1 System Description	60
	4.3.5.2 Pulse Generator	61
	4.3.5.3 CPU	61
	4.3.5.4 Receiver Amplifier	62
	4.3.5.5 Master Clock, ADC and Display	62
4.4	Others Equipment	62
4.5	Samples Preparations	63
4.5.1	Stage One	63
4.5.2	Stage Two	65

4.6	Error	69
4.6.1	Random Error and Systematic Error	70
4.7	Summary	70
5	RESULTS AND DISCUSSIONS	71
5.1	Introduction	71
5.2	Ultrasonic Characteristics of Standing Oil Palm Tree	72
5.2.1	Ultrasonic Velocity	72
5.3	Density of Oil Palm Trunk for Cutting Samples	76
5.4	Moisture Contents (Wet Basis) of Oil Palm Trunk for Cutting Samples	79
5.5	Ultrasonic Characteristics of Oil Palm Trunk for Cutting Samples	80
5.5.1	Ultrasonic Velocity	80
5.5.2	Elasticity Constant of Oil Palm Trunk	85
6	CONCLUSIONS AND FUTURE DIRECTIONS	89
6.1	Conclusions	89
6.2	Future Directions	91
	REFERENCES	93
	APPENDICES	99
	BIODATA OF STUDENT	108
	LIST OF PUBLICATIONS	109