

UNIVERSITI TEKNOLOGI MARA

**RESPONSE OF YOUNG OIL PALMS
TO COMBINATION OF EFB
COMPOST AND SLOW-RELEASE
FERTILIZER (SRF) IN LOAMY
SAND SOIL**

SIRAJ MUNIR BIN MOHAMMAD

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Plantation and Agrotechnology

August 2022

ABSTRACT

Oil palm (*Elaeis guineensis*) has become one of the largest contributors among the agriculture commodities towards the Malaysian economy and being the main source of income especially for the smallholders. In meeting the large demands of export from consumer countries, cultivation of oil palm has shifted even towards marginalized lands. Large amounts of fertilizers are being applied in oil palm cultivation in sandy coastal soil having high porosity to overcome the loss of nutrients from leaching. The objective of the study was to determine the effect of the combination of slow-release fertilizers (SRF) and empty fruit bunch (EFB) compost on the growth of two years' old oil palm in coastal sandy soil. An experiment with Randomized Complete Block Design (RCBD) was conducted with five fertilizer treatments replicated four times over 18 months, from 28 May 2017 until 28 November 2018. The treatments were: T1 (100% NPK fertilizer), T2 (50% NPK + 50% SRF), T3 (100% SRF), T4 (50% NPK + EFB compost), and T5 (50% SRF + EF compost) of equivalent 100 g Nitrogen (N). The effect of the treatments on soil physical and chemical properties that included soil moisture, bulk density, soil texture, soil pH, soil total N, and soil available P were determined. The plant N and plant P content from Frond 9 and the growth of oil palm based on palm height, palm bole diameter and leaf area were also determined. The analysis did not indicate significant differences between treatments for soil physical properties. Similarly, soil chemical analysis of soil pH, soil total N and soil available P did not indicate significant differences between treatments. There were no significant differences obtained in the plant N and plant P content. For palm growth, steady growth was observed for all treatments although ANOVA indicated no significant differences. A significant positive but weak correlation of Pearson Correlation Coefficient of 0.698 between bole diameter and leaf area was obtained. There was also significant positive correlation between leaf N content and the bole diameter and leaf area with Pearson Correlation Coefficients of 0.359 and 0.520, respectively. The study concluded that despite reducing the amount of either NPK or SRF chemical fertilizer application to 50% and combining EFB compost supplying the balance of the 50% N, the palm growth is still able to be on par with 100% N from the chemical fertilizers. The recommendation of the combination of SRF and EFB compost was made due to the cost factor attributed by the higher frequency of NPK fertilizer application requiring four times per year as compared to SRF at two times thus reducing labour cost. The findings have showed that despite no significant difference was observed between treatments, cost analysis showed reduction in cost of input. This finding provides smallholders with an alternative method for fertilizer application.

ACKNOWLEDGEMENT

Alhamdulillah. First and foremost, I wish to thank Allah S.W.T for all His guidance in giving me the opportunity to embark on my Master journey and complete this long and challenging journey successfully. My deepest gratitude and appreciation to my main supervisor Assoc. Prof. Dr. Margaret Chan Kit Yok for her guidance, understanding, commitment and expertise in guiding me through this journey. I am deeply indebted and extend my sincere appreciation to my co-supervisor, Assoc. Prof. Dr. Hasmah Bt. Mohidin for her valuable and countless advice and motivation especially when everything seems bleak.

I would like to acknowledge and am extremely grateful to Kiel Energy Sdn Bhd, Daitoku Sdn Bhd, Pantu Plantation and UiTM Sarawak Branch Campus for the financial support in funding the research work and the site to execute this study.

I greatly appreciate the kind assistance of the supporting staff of the Faculty of Plantation laboratory of UiTM Sarawak especially Miss Siti Rahimah Bt. Ibrahim and Mr. Maie B. Sabang for technical supports. I also acknowledge the collaboration of research activities with some final year students of the Bachelor of Science (Hons.) Plantation Management and Technology whose names are not mentioned here.

Above all, I deeply thank my family members, my father, Hj Mohammad B. Suni, my mother, Hjh Dyg Hasiah Bt. Hj Abg Bohan for their sacrifice, love, understanding and endless moral support. To my cousin, Abg Muhd Faiz B. Abg Zaidi, who has helped me through thick and thin. To my friends, Mohd Zulfadhli B. Zainuddin, Shairazi B. Effrim, Wan Muhammad Fahrurrazi B. Wan Abdul Wahab, and Koki Asano, who without them, I would have never been able to get to where I am today.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xi
LIST OF SYMBOLS	xv
LIST OF ABBREVIATIONS	xvi
LIST OF NOMENCLATURE	xvii
CHAPTER ONE INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	3
1.3 Research Question	3
1.4 Objectives	4
1.5 Significance of Study	4
1.6 Scope and Limitation of Study	5
CHAPTER TWO LITERATURE REVIEW	6
2.1 Oil Palm	6
2.1.1 Historical Impact of Oil Palm Industry	6
2.1.2 Current Performance of Oil Palm Industry	7
2.1.3 Oil Palm Taxonomy and Botany	8
2.1.4 Ideal Soil Type for Oil Palm Cultivation	9
2.2 Soil Characteristics of Sandy Soil	9
2.2.1 Oil Palm Cultivation in Marginal Soil	11
2.3 Soil Biological properties	11
2.4 Soil Organic Matter	11

2.5	Macronutrients of N, P, and K Requirement of Oil Palm	12
2.5.1	Advantages of Chemical Fertilizer	14
2.5.2	Disadvantages of Chemical Fertilizers	14
2.6	Soil Al, soil Fe, exchangeable H and acidity, soil electrical conductivity, and soil cation exchange capacity	15
2.7	Fertilizer Regime in Oil Palm Plantation and Limitation in Marginal Soil	16
2.8	Limitations of chemical fertilizer (NPK) in coastal sandy soil	17
2.9	Slow-Release Fertilizer	17
2.9.1	Benefits of Slow-Release Fertilizer	17
2.10	EFB Compost	18
2.10.1	Benefits of Empty Fruit Bunch (EFB) Compost	19
2.10.2	Demerits of using Empty Fruit Bunch (EFB) Compost	19
2.11	Oil Palm Growth	20
2.11.1	Plant Height of Oil Palm Index	20
2.11.2	Bole Diameter	20
2.11.3	Leaf Area	21
2.11.4	Leaf Area Measurement using AutoCAD	23
2.12	Determination of Physical and Chemical Properties of Soil	24
2.12.1	Soil Moisture	24
2.12.2	Soil Texture	25
2.12.3	Soil Bulk Density	27
2.12.4	Soil pH	28
2.12.5	Soil Total N	29
2.12.6	Soil Available P	29
	CHAPTER THREE RESEARCH METHODOLOGY	31
3.1	Experimental Layout	31
3.2	Plant Materials and Growth Conditions	31
3.3	Plot Maintenance	31
3.4	Experimental Design and Treatment	32
3.5	Research Flow Chart	34
3.6	Data Collection on Soil Properties	35
3.6.1	Soil Sampling	35
3.6.2	Soil Moisture	35