

**FORMULATION OF AN ORGANIC-BASED LIQUID
FERTILIZER FOR HYDROPONIC LETTUCE**

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Degree of Master of Science

Department of Environmental Engineering

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Thesis submitted in partial fulfillment of the requirements for the
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DECLARATION OF THE CANDIDATE & SUPERVISOR

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Abstract

The consumer demand for hydroponically grown leafy vegetables has been rapidly expanding worldwide, among which lettuce is paramount. Consequently, with the escalating usage of inorganic fertilizers, adverse impacts on human health and the environment have been widely recognized. Thus, this study aimed to investigate the effect of organic-based liquid fertilizers (OBLFs) produced using agro-industrial residuals and excretory animal waste on the vegetative growth of Leaf Lettuce (*Lactuca sativa* L.). The Vermiwash method was employed to produce nine different OBLFs from neem leaves, gliricidia leaves, cow dung, rice husk, goat manure, banana pseudostem, poultry litter, and coconut oil cake whereas the anaerobic fermentation method was employed to produce OBLF from fish waste. The Albert's solution, a generally utilized chemical liquid fertilizer (CLF) in commercial hydroponics was used as the control. The electrical conductivity (EC), pH, and germination percentage of OBLFs were studied. The Leaf Lettuce was cultivated in a Kratky hydroponic system containing each produced OBLF under the Completely Randomized Design (CRD). Results showed that the range of EC and pH is as follows: EC 1116.3 - 7264.6 $\mu\text{S}/\text{cm}$ and pH 6.5–9.5. All fertilizers except fish amino acid (FAA) had more than 80 % germination percentage, indicating non-phytotoxic characteristics in OBLFs. The rice husk-derived liquid fertilizer (RH) showed the significantly highest shoot fresh weight (75.2 g), root fresh weight (4.6 g), root dry weight (0.7 g), and maximum root length (43.8 cm) ($P < 0.05$). The goat manure-derived liquid fertilizer (GM) showed the significantly highest shoot length (16 cm), leaf width (16.7 cm), leaf length (19.9 cm), and leaf surface area (332.6 cm^2). The highest chlorophyll content was found in the CLF ($18.3 \pm 4.1^a \mu\text{g}/\text{cm}^2$) and RH ($17.7 \pm 1.0^a \mu\text{g}/\text{cm}^2$), ($P > 0.05$). The highest number of leaves and shoot dry weight were found in the CLF ($P < 0.05$). The best vegetative growth was obtained by the RH followed by GM in contrast to the CLF, which could be promisingly utilized in hydroponics for growing lettuce.

Keywords: Organic-based liquid fertilizer; Hydroponics; Lettuce; Vermiwash; Fish amino acid

TABLE OF CONTENTS

Declaration of The Candidate & Supervisor	i
Acknowledgements	ii
Abstract	iii
Table of Contents	iv
List of Figures	vi
List of Tables	vii
List of Abbreviations	viii
Chapter 1	1
Introduction	1
1.1 General Objective	4
1.2 Objectives	4
Chapter 2	5
Literature Review	5
2.1 Origin of Lettuce	5
2.2 Botany of Lettuce	5
2.3 Types of Lettuce	5
2.4 Nutritional Value of Lettuce	6
2.5 Global Production of Lettuce	7
2.6 Lettuce Cultivation Methods	7
2.7 Hydroponic Cultivation	8
2.7.1 Nutritional Requirement for Hydroponic Cultivation	8
2.7.2 Benefits and Problems of Hydroponic Cultivation	9
2.8 Techniques of Hydroponic Cultivation	9
2.9 Fertilizer application in Hydroponic Cultivation	10
2.9.1 Global Utilization of Chemical Fertilizers	10
2.9.2 Impact of Utilizing Chemical Fertilizers	11
2.10 Organic Cultivation	12
2.10.1 Organic Hydroponic Cultivation	13
2.10.2 Application of Organic-Based Liquid Fertilizers in Hydroponic Cultivation	13
2.10.3 Sources for Organic Liquid Fertilizer Production	14
2.11 Vermiwash Production Using Vermicomposting	15
2.11.1 Earthworms	16
2.11.2 Composition of Vermiwash	17
2.11.3 Effect of Vermiwash in Plant Growth	17
2.11.4 Effect of Vermiwash as a Pesticide	18
2.11.5 Effect of Application of Vermiwash in	19

Hydroponic Cultivation	
2.12 Fish Amino Acid, Benefits, and Its Applications	19
2.13 Raw Materials for Liquid Organic Fertilizer Production	20
2.13.1 Neem Leaves	20
2.13.2 Gliricidia Leaves	21
2.13.3 Cow Dung	21
2.13.4 Rice Husk	22
2.13.5 Goat Manure	22
2.13.6 Spent Mushroom Substrate	23
2.13.7 Banana Pseudostem	24
2.13.8 Poultry Litter	24
2.13.9 Coconut Oil Cake	25
2.13.10 Fish Waste	25
Chapter 3	27
Materials and Methods	27
3.1 Collection of Raw Materials	27
3.2 Preparation of Raw Materials	28
3.3 Preparation of Vermiwash	28
3.4 Preparation of Fish Amino Acid (FAA)	29
3.5 Chemical Liquid Fertilizer	29
3.6 Measuring the EC and pH of Different Fertilizers for Checking the Feasibility of Using as Hydroponic Nutrient Solutions	30
3.7 Determining the Phytotoxicity of Different Fertilizers	31
3.8 Experimental Design	31
3.9 Preparation of the OBLF for Crop Establishment	31
3.10 Testing the Effect of OBLFs on Vegetative Growth of Hydroponic Lettuce	32
3.11 Statistical Analysis	32
Chapter 4	34
Results	34
4.1 EC and pH of OBLFs	34
4.2 Phytotoxicity of Different Fertilizers	35
4.3 Effect of OBLFs on the Vegetative Growth of Hydroponic Lettuce	36
Chapter 5	43
Discussion	43
Chapter 6	56
Conclusion and Recommendation	56
References	58

LIST OF FIGURES

Figure	Description	Page
Figure 3.1	Layout of the CRD	30
Figure 3.2	Methodology	33
Figure 4.1	Electrical conductivity of different organic-based liquid fertilizers.	34
Figure 4.2	pH of different organic-based liquid fertilizers.	35
Figure 4.3	Germination percentage of different organic-based liquid fertilizers.	36
Figure 4.4	Effect of different organic-based liquid fertilizers on leaf characteristics, leaf number (a) and chlorophyll content (b) of leaf lettuce.	37
Figure 4.5	Effect of different organic-based liquid fertilizers on leaf morphological characteristics, leaf width (a), leaf length (b), and leaf surface area (c) of leaf lettuce.	39
Figure 4.6	Effect of different organic-based liquid fertilizers on shoot characteristics, shoot height (a), shoot fresh weight (b), and shoot dry weight (c) of leaf lettuce.	40
Figure 4.7	Effect of different organic-based liquid fertilizers on root characteristics, maximum root length (a), root fresh weight (b), and root dry weight (c) of leaf lettuce.	41
Figure 4.8	The effect of the chemical liquid fertilizer and different organic-based liquid fertilizers on root growth of lettuce.	42
Figure 5.1	The overall growth performance of differently treated leaf lettuce in Kratky hydroponic units.	54

LIST OF TABLES

Table	Description	Page
Table 3.1	Organic-based liquid fertilizers from each feedstock.	27
Table 5.1	Effect of chemical liquid fertilizer (C1) and nine different liquid organic fertilizers (NL-FAA) on vegetative growth of Leaf Lettuce at harvest.	53

LIST OF ABBRIVIATIONS

Abbreviation	Description
BP	Banana Pseudostem
C	Control
CAGR	Compound Annual Growth Rate
CD	Cow Dung
CLF	Chemical Liquid Fertilizer
C: N	Carbon / Nitrogen Ratio
CRD	Completely Random Design
CRH	Composted Rice Husk
COC	Coconut Oil Cake
cwt	Hundredweight
DFW	Dried Fish Waste
DWC	Deep Water Culture
EC	Electrical Conductivity
FAA	Fish Amino Acid
FW	Vegetable Food Waste
GL	Gliricidia Leaves
GM	Goat Manure
ha	Hectare
HNS	Hydroponic Nutrient Solution
OLF	Organic Liquid Fertilizer
MSW	Municipal Solid Waste
NFT	Nutrient Film Technique
NPK	Nitrates, Phosphates, Potash
NL	Neem Leaves
OBLFs	Organic-Based Liquid Fertilizers
PL	Poultry Litter
RH	Rice Husk
SMS	Spent Mushroom Substrate
T	Treatment
t/ha	Tonnes / Hectare
TKN	Total Kjeldahl Nitrogen