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**EFFECTIVITY OF CITRONELLA GRASS AND  
GINGER AS TERMITE EXTERMINATOR**

by

CAMELA DIANA A. ALULOD  
RAYMUND BENZ D. LATONIO  
REEVE ADAM P. MOROTA  
LIEZEL C. SEMPRON

## **ABSTRACT**

Camela Diana A. Alulod, Raymund Benz D. Latonio, Reeve Adam P. Morota, Liezel C. Sempron, **“Effectivity of Citronella Plant and Ginger as Termite Exterminator”**  
Undergraduate Technical Research. Bachelor of Science in Civil Engineering.

Adviser: Engr. Jennifer C. Cacal

Effectivity of Citronella grass and Ginger as Termite Exterminator was conducted at Brgy. San Pedro, Puerto Princesa City in July 2018 to test the effectivity of Citronella Grass and Ginger extracts against termites, the mortality of termites against different levels of concentrations of Citronella Grass and Ginger and compare the cost with the commercial termite exterminator. The treatments used were Treatment 1 (No Treatment), Treatment 2 (40% Ginger extract + 40% Citronella Grass extract + 20% distilled water), Treatment 3 (60% Ginger extract + 20% Citronella Grass extract + 20% distilled water), Treatment 4 (20% Ginger extract + 60% Citronella Grass extract + 20% distilled water) and Treatment 5 (commercial termite exterminator). Citronella Grass and Ginger extracts and commercial termite exterminator were sprayed into the plastic container containing termite. Termite mortality rate was observed and noted every 30 minutes for 2 hours. Results revealed that the higher concentration of ginger is more effective among the different concentration of treatments. The organic termite exterminator is expensive than the commercial termite exterminator.

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## APPENDIX A

### Documentation

The materials and procedure in preparation of the treatment in this study.



Citronella grass and ginger, the main ingredients used in this study.



Termite was used for the testing of the treatment in this study.



The bottle spray used for applying  
the treatment on the termites



The plastic container used  
for containing the termites.



(A)



(B)



(C)



(D)



(E)



(F)

(A) Juicer used for obtaining the extract from the ginger and citronella plant (B) Scissors used for cutting the citronella plant (C) sticks used for transferring the termites to the container (D) chemical termite exterminator used on the termites for comparison on the organic exterminator (E) face mask used by the researcher to avoid possible harmful effect (F) Gloves used by the researcher to avoid contamination.



Cleaning the citronella grass using distilled water.



Cutting the ginger into pieces



Extraction of citronella plant



Extraction of ginger



Extracted Ginger and Citronella Grass



Preparation of termite



Application of treatment



Observation of Treatment 1



Observation of Treatment 2



Observation of Treatment 3



Observation of Treatment 4



Observation of Treatment 5

## APPENDIX B

### Cost Computation of Treatments

Ginger

$$\text{cost} = \frac{\text{unit price}}{\text{unit volume}} \times \text{desired volume}$$

$$\text{cost of ginger} = \frac{\text{Php } 20}{250\text{mL}} \times 450 \text{ mL} = \text{Php } 36.00$$

Citronella grass

$$\text{cost} = \frac{\text{unit price}}{\text{unit volume}} \times \text{desired volume}$$

$$\text{cost of citronella grass} = \frac{\text{Php } 340}{150\text{mL}} \times 150\text{mL} = \text{Php } 340.00$$

Distilled Water

$$\text{cost} = \frac{\text{unit price}}{\text{unit volume}} \times \text{desired volume}$$

$$\text{cost of Distilled Water} = \frac{\text{Php } 15}{500 \text{ mL}} \times 150 \text{ mL} = \text{Php } 4.50$$

750 mL Spray Bottle

$$\text{cost of spray bottle} = \text{Php } 200.00$$

Labor Cost

$$\text{cost of labor} = \text{Php } 19.50$$

$$\text{Total} = 36.00 + 340.00 + 4.50 + 200.00 + 19.5 = \text{Php } 600$$

## APPROVAL SHEET

This is to certify that we have supervised the preparation of and read the research paper prepared by **Camela Diana A. Alulod, Raymund Benz D. Latonio, Reeve Adam P. Morota, Liezel C. Sempron** entitled **Effectivity of Citronella Grass and Ginger as Termite Exterminator** and that the said paper has been submitted for final examination by the Oral Examination Committee.

**JENNIFER C. CACAL, MEPCE**

Adviser

As members of the Oral Examination Committee, we certify that we have examined this paper and hereby recommend that it be accepted as partial fulfillment of the undergraduate requirement for the Degree **Bachelor of Science in Civil Engineering**.

**JAYSON J. JARANILLA, RCE**

Panel Member 1

**NENA G. ZARA, MSEM**

Panel Member 2

This research paper is hereby approved and accepted by the College of Engineering, Architecture & Technology as partial fulfillment of the undergraduate requirement for the Degree **Bachelor of Science in Civil Engineering**.

**ELUCILA M. SESPEÑE, PhD**

Dean, College of Engineering, Architecture & Technology

## Chapter 1

### INTRODUCTION

Residential building and infrastructure like hotels and resorts are made of concrete and steel but woods are still essential material to use because of its aesthetic. Apparently, woods are susceptible to termite attacks that weaken and reduce the stability of the structure. Termites can destroy houses undetected that's why they are called "silent destroyers". In order to prevent termite infestation, there are chemical pesticides available in the market that contain harmful properties. However, a recent research shows that citronella grass has antifungal properties that can be used as a pesticide (Boldt, 2015). Because of its high citral and geraniol content, citronella grass is known to repel bugs such as mosquitos and ants. In addition, *Zingiber officinale* basically known as "ginger" is a hot fragrance spice made from the rhizome of a plant, which may be chopped or powdered for cooking, preserve in syrup, or candied and its oil can exterminate insects (Jummie, 2014). The information mentioned above caught the researchers' attention and came up with this research entitled "Effectivity of Citronella grass and Ginger as Termite Exterminator".

The main objective of this study is to produce an organic termite exterminator using citronella grass and ginger. It aims to identify the most effective treatment ratio of citronella grass and ginger, compare the effectiveness of citronella grass and ginger as organic termite exterminator with the commercial termite exterminator through mortality rate and cost; and computed the cost of organic termite exterminator compared to commercial termite exterminator.

The environment is now in a highly polluted state. Chemical termiticides cause air pollution. The study aims to produce an organic termite exterminator that will be an eye opener to everyone; not only chemical termite exterminators are effective but also organic ones.

The researchers found studies that proves that organic materials can also be used as a termite exterminator. The research studies entitled “Termiticidal Effects of African Locust Bean (*Parkia biglobosa*) Seed Oil Extracts” and “Development of Cashew Nut Shell Liquid based Termiticide by using Chemicals” used survival chance and mass loss respectfully to determine its efficacy. The research study entitled” Zingiber Extract as an Alternative Termotoide Buster” used mortality rate to determine if the ginger extract can be an alternative source in making termite killer. The studies show some promising results that as an organic material mixed with other chemical gradients, it is capable of exterminating termites. Another study entitled “*Jatropha curcas linn* (tuba-tuba) Leaves and Fruit Extract as Termiticide” used pure organic material without mixing any chemical but still capable of exterminating termites this research also used mortality rate as its method for determining the efficacy of the termiticide.

After comprehending the related literatures, the researchers formulated this study. The other research studies only focused on one organic material to use as a termiticide, while this research will use two organic materials to heighten its effectivity. The researchers will use mortality rate to determine the efficacy of the termite exterminator by means of spraying the treatment through termites directly.

The study focused only on the effective properties of citronella grass and ginger as termite exterminator. However, the study did not cover the identification of other chemical composition that the citronella grass and ginger may contain. The researcher only used the

leaves and stalks of citronella grass (*Cymbopogon nardus*) that is available locally and have the properties to repel mosquitos. And only the rhizome of locally produced ginger is used. The researchers tested the effectiveness of the treatment on termites specifically the subterranean termites that is usually found in local areas. This study covered dates from November 2017 to September 2018 at Puerto Princesa City.

## **Chapter 2**

### **REVIEW OF RELATED LITERATURE AND STUDIES**

This chapter offers other literature and studies that are correlated to the current studies in producing organic termite exterminator to detect the missing part in literature and attest the assertions of this study.

#### **2.1 Review of Related Literature**

##### **2.1.1 Termites**

Termites also known as “white ants” are insects classified at the order Isoptera that live in colonies and divide labor between classes. Termites regularly feed on rotting plant material, commonly in the form of wood, leaf litter, soil or animal manure. Out of estimated 4,000 species, about 10 percent are recognized as pests that can bring serious physical damage to wooden structures, trees, and plantations. Termites are prominent detritivores, predominantly in the tropical and subtropical regions, and decomposing wood and other plant material makes them important (Jummie, 2014). The other type of termite can live from 12 to 24 months. They can also chew over asphalt, lead, plaster or mortar to discover wood (Eiseman, 2010).

#### **3 Major Types of Termites**

##### **Dampwood Termites**

Dampwood Termites usually found living in wood laying in the ground, though touching the ground is not necessary when the wood has high moisture. Because they want

high moisture, dampwood termites are most frequently located in cool, humid areas along the coast and are the common pests of beach houses. Dampwood termite winged reproductives, called swarmers, are usually approaching to lights. Winged reproductives usually swarm among July and October, but it is not strange to see them at other times of the year (Jummie, 2014).



**Figure 2.1.1** Dampwood Termites  
(Raptis, 2005)

### Subterranean Termites

Subterranean termites necessitate slightly or barely wet surroundings. They usually live in or near the soil to fulfill this need and conserve some connection with the soil through channels in wood or through shelter tubes they build. Soil with bits of wood or even plasterboard usually shelter tubes are made of. Foundations and structural support wood can be damaged because of them. They are regularly discovered in rotten wood (Jummie, 2014).



**Figure 2.1.2** Subterranean Termites  
(Campbell, 2017)

### Drywood Termites

Drywood termites always attack a dry and undecayed wood such as structural lumber, lumber in storage, dried limbs of wild trees and post. Drywood termites usually transfer on sunny days in nearby structures or buildings. (Jummie, 2014)



**Figure 2.1.3** Drywood Termites  
(Massey Services Inc., 2017)

### **2.1.2 Lemongrass**

There are two types of lemongrass: *Cymbopogon citratus* and *Cymbopogon nardus*. *Cymbopogon citratus* is essential for cooking while the *Cymbopogon nardus* is poisonous plant that can repel mosquitos and usually use to decorate in the resorts or gardens.

### *Cymbopogon citratus* (Tanglad)

*Cymbopogon citratus* is used as flavoring in food dishes because of its citrus-like aroma that gives different piquancy in fish, soup, stews, marinating, and food dressings. In Philippines, *Cymbopogon Citratus* commonly ingredient of Filipino food delicacy called Tinolang Manok. (Herbalist of MDidea Extracts Professional, 2014).



**Figure 2.1.4** *Cymbopogon citratus*  
(Hochkompturei, 2014)

### *Cymbopogon Nardus* (Citronella Grass)

*Cymbopogon Nardus* is from the family of Poaceae grass, it grows to 2m and commonly looks like as *Cymbopogon citratus*. In contrast *Cymbopogon Nardus* has red/magenta base stems and not appropriate to eat because of its unpleasant nature. And has an oil recognized as “citronella oil” that can exterminate termites (Rose, 2017).



**Figure 2.1.5** Cymbopogon Nardus  
(Man, 2014)

### 2.1.3 Ginger

*Zingiber officinale* locally known as Ginger is from the family of Zingiberaceae. It is a rhizome reed-like plant with leafy stems and a ginger root that used as a food delicacy, medicine, turmeric tea and as spices. (Jummie, 2014).



**Figure 2.1.6** Ginger  
(Steven Foster, 2016)

## **2.2 Review of Related Studies**

### **2.2.1 Termiticidal Effects of African Locust Bean (*Parkia Biglobosa*) Seed Oil Extracts**

*Parkia biglobosa* (African locust bean) tree is a perennial deciduous tree that grows from 7 to 20 meters high (Teklehaimanot, 2004). Previous studies of *Parkia biglobosa* have stated the anti-microbial actions of the stem bark and leaf (Ajaiyeoba, 2002). The acetone and aqueous extract of *P. biglobosa* raw beans have also demonstrated a property of termiticide. (Femi-Ola et al., 2008). In this study, African locust bean were the main component to develop suitable non-chemical means and eco-friendly products such as botanicals and microbial pathogen reported to have termiticidal effects.

To control termite infestation instead of using poisonous chemicals, used the extract of African locust bean seeds because it also has a termiticidal effect to exterminate termites. The survival chances for termites decrease by 400%. Observations on the termites' response to the oil samples were noted, monitoring how the termites died per minute with respect to each extract.

After the conducted experiment, the survival chance of termites was found. Among the locust bean oil extract from acetone and ethanol of the raw seeds, it shows that the extracted oil from ethanol was the best for eradicating termites.

### **2.2.2 Effectivity of Tuba-Tuba Leaves Extract as Termite Killer**

The study entitled "Effectivity of Tuba-tuba (*Jatropha curcas* L.) Leaves Extract as Termiticide" was conducted at Brgy. Sta Monica, Puerto Princesa City in August 2016 to test the effectiveness of Tuba-Tuba leaves extract against termites and the mortality of termites

treated with different levels of concentration of Tuba-tuba leaves extract (Abin, et. al, 2016). The treatments used were Treatment 1 (20% Tuba-tuba leaves extract + 80% Distilled water), Treatment 2 (30% Tuba-tuba leaves extract + 70% Distilled water), Treatment 3 (40% Tuba-tuba leaves extract + 60% Distilled water), Treatment 4 (50% Tuba-tuba leaves extract + 50% Distilled water) and Treatment 5 (Control – Solignum). (Abin, et. al, 2016).

Tuba-tuba leaves extract concentrations were gradually poured down into the perforated tubes and different concentration of treatments was applied into termites inside the cages and termite mortality after three (3) days and five (5) days of treatment application was observed and noted. Results revealed that the mortality of termites treated at different concentrations was lower than that of using commercial termiticide. From the observation, the mortality of termites increases as the concentration of *Jatropha Curcas* Linn leaves extract increases (Abin, et. al, 2016).

### **2.2.3 Development of Cashewnut Shell Liquid based Termiticide by using Chemicals**

Cashew nut shell consists of reddish brown, viscous, strongly vesicant liquid about 30-35 % of the cashew nut shell called CNSL (Behrens, 1996) which constitutes of 80-90 % anacardic acid and 10-20 percent cardols (Tyman, 1979). Anacardic acid, a bioactive phytochemical, is a mixture related to organic compounds. It consists a salicylic acid substituted with an alkyl chain and can be used as anti-termite, bactericide, fungicide, insecticide (Mahadevappa, et. al, 2012)). The study was undertaken to develop suitable termiticide using the CNSL with Chlorpyrifos, Copper naphthenate and Boric acid to be suited to the sustainable development of agriculture (Kamble, N., S., & A., 2017)

Wood sticks were cut in to pieces, polished and made 30 cm long and 2.5 cm average diameter specimen. Specimens were marked with red color at upper end and labelled as per the treatments. The weight of each specimen was noted. Wood specimens were treated with formulations by surface application and dipping method. Then these specimens were tested in the termite infested field on the mounds for 60 days. Response of termite to the specimens treated with different formulations was recorded in the form of mass loss percentage. The CNSL treatment with Chlorpyrifos were found more effective against termite attack than those with Copper naphthenate and Boric acid.

#### **2.2.4 *Jatropha Curcas* Linn (Tuba-Tuba) Leaves and Fruits Extracts as Termiticide**

The study entitled “*Jatropha Curcas* Linn (Tuba- tuba) leaves and fruit extracts as Termiticide” was conducted at Brgy. Sta. Monica, Puerto Princesa City from August 2017 to test the effectiveness of Tuba-Tuba leaves and fruit extract against termites and the mortality of termites treated with different levels of concentrations of Tuba-tuba leaves and fruit extract (Doydora, et. al, 2017).

The treatments used were Treatment 1 (No treatment), Treatment 2 (75% Tuba-tuba leaves extract + 5% Tuba-tuba fruits extract + 20% Distilled water), Treatment 3 (75% Tuba-tuba leaves extract + 10% Tuba-tuba fruits extract +15% Distilled water), Treatment 4 (75% Tuba-tuba leaves extract + 15% Tuba-tuba fruits extract + 11% Distilled water) and Treatment 5 (Control – Solignum) (Doydora, et. al, 2017).

Tuba-tuba leaves and fruits extract concentrations were gradually poured down into the perforated tubes and different concentration of treatments was applied into termites inside

the cages and termite mortality after three (3) days and five (5) days of treatment application was observed and noted. Results revealed that the mortality of termites treated at different concentrations was lower than that of using commercial termiticide. From the observation, the mortality of termites increases as the concentration of *Jatropha Curcas* Linn leaves and fruits extract increases (Doydora, et. al, 2017).

### **2.2.5 Zingiber Extract as an Alternative Termotoide Buster**

The study entitled “Zingiber Extract as an Altenative Termotoide Buster” was conducted at Mapandan National High School, Mapandan, Pangasinan during the S.Y. 2013-2014 to prove if the ginger extract can be an alternative source in making the termite killer.

The set-ups used were Set-Up A (100% Ginger extract), Set-Up B (70% Ginger extract + 30% Distilled water), Set-Up C (50% Ginger extract + 50% Distilled water) and Set-Up D (Commercial Termite buster).

The set-ups were applied directly to the termites. They used the counting method to determine the number termites busted. The results show that Set-Up A is as effective as the commercial one because it is more concentrated compared to Set-Up B & Set-Up C. The findings of the study proved that Set-Up A (100% Ginger Extract) can be an alternative ingredient on making termite killer.

## **CHAPTER 3**

### **MATERIALS AND METHODS**

This chapter, the proponents present the materials and procedures used to produce the termite exterminator; the methods that the researchers used to determine the effectivity of the organic termite exterminator; and formulate equation to compute the cost, in order to compare its efficacy and difference in cost with the commercial termite exterminator.

Termite exterminator are usually manufactured using chemicals which are proven effective to kill termites. However, in this study, the researchers aimed to create an organic exterminator killer using citronella grass and ginger.

#### **3.1 Methodology**

##### **Preparation of Ginger and Citronella grass**

1. Collect fresh citronella grass and ginger
2. Wash the citronella grass and ginger using distilled water
3. Peel the ginger using knives
4. Cut the leaves and stalks of citronella grass into pieces using knives.
5. Put it in the container and set aside for safekeeping.

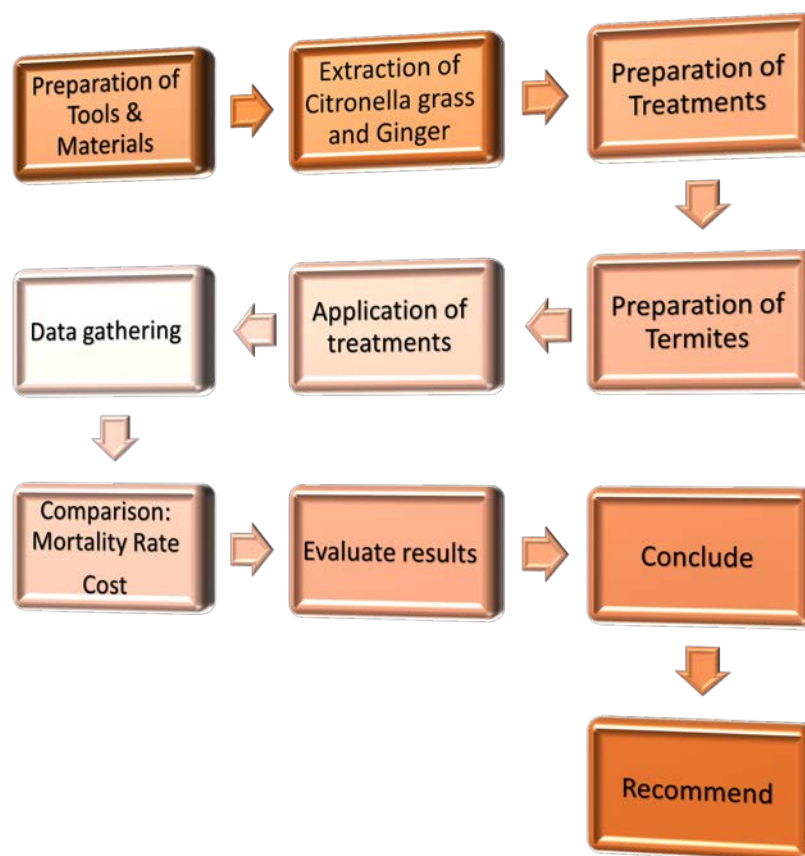
##### **Preparation of treatments**

1. Place the prepared ginger into the juicer
2. Collect the ginger extract
3. Repeat steps 1 to 2 until the desired amount is produced
4. Same procedure will be used to extract of citronella grass.

5. The ratios of the treatments are shown below.

**Table 3.1** Treatments

| Treatment    | Ginger Extract |            | Citronella Extract |           | Distilled Water |           | Total mL |
|--------------|----------------|------------|--------------------|-----------|-----------------|-----------|----------|
|              | Percentage %   | Volume, mL | Percentage %       | Volume mL | Percentage %    | Volume mL |          |
| Treatment #1 | 0              | 0          | 0                  | 0         | 0               | 0         | 0        |
| Treatment #2 | 40%            | 10         | 40%                | 10        | 20%             | 5         | 25       |
| Treatment #3 | 60%            | 15         | 20%                | 5         | 20%             | 5         | 25       |
| Treatment #4 | 20%            | 5          | 60%                | 15        | 20%             | 5         | 25       |
| Treatment #5 | 0              | 0          | 0                  | 0         | 0               | 0         | 25       |



**Figure 3.2** Flow Chart

## Preparation of Termites

100 subterranean termites were collected. 20 subterranean termites were placed in each sterilized plastic container. The termites were carefully collected using sticks to prevent harming them.

## 3.2 Research Design

A quantitative research was followed. This research used an experimental type of study to identify the most effective treatment ratio, to compare the effectiveness of citronella grass and ginger as termite exterminator with the commercial termite exterminator in terms of mortality and cost.

## 3.3 Data Gathering

After the placing of the termites inside the plastic containers, the treatments were sprayed directly into the termites. The test subjects were observed for 2 hours. For every thirty (30) minutes, the number of exterminated termites in each plastic container were counted and recorded.

The following formula was used to acquire the mortality rate of termites

$$MR = \frac{n_D}{n_T} \times 100\% \quad (\text{Equation 3.1})$$

Where:

$n_T$  = Total Number termites

$n_D$  = Number of dead termites

The estimated price of organic termite exterminator was computed using the formula below.

$$\text{Total cost} = \text{cost of citronella grass} + \text{cost of ginger} + \text{bottle} + \text{distilled water} + \text{production rate} \quad (\text{Equation 3.2})$$

### **3.4 Data Gathering Instrument**

#### **3.4.1 Materials**

5 pcs - Sterilized Plastic Container

Citronella grass (*Cymbopogon nardus*)

Ginger

Subterranean Termites

Piece of wood damaged by the termites

Distilled Water

#### **3.4.2 Tools**

Juicer

Face masks

Gloves

Stick

Bottle spray

Knives

## CHAPTER 4

### RESULTS AND FINDINGS

#### 3.1 Results and Findings

**Table 4.1** Time death of termites

| TIME    | TREATMENT<br>1 | TREATMENT<br>2 | TREATMENT<br>3 | TREATMENT<br>4 | TREATMENT<br>5 |
|---------|----------------|----------------|----------------|----------------|----------------|
| 1:05 PM | 0              | 0              | 0              | 0              | 0              |
| 1:35 PM | 0              | 1              | 16             | 3              | 8              |
| 2:05 PM | 0              | 4              | 0              | 4              | 3              |
| 2:35 PM | 0              | 0              | 3              | 8              | 7              |
| 3:05 PM | 0              | 12             | 0              | 0              | 2              |

The time of death of termites were observed per treatment every 30 minutes for 2 hours. The fastest extermination of termites was observed in Treatment 3 (60% Ginger extract + 20 % citronella extract + 20% distilled water) with 16 numbers of termites exterminated at 1:35 pm, followed by Treatment 5 (Chemical Treatment) with 8 termites at 1:35 pm, Finally, Treatment 4 (20% Ginger extract + 60 % citronella extract + 20% distilled water) with 3 termites exterminated at 1:35 pm.

**Table 4.2** Mortality Rate

| TREATMENT   | NUMBER OF DEAD<br>TERMITES | MORTALITY<br>RATE |
|-------------|----------------------------|-------------------|
| TREATMENT 1 | 0                          | 0%                |
| TREATMENT 2 | 17                         | 85%               |
| TREATMENT 3 | 19                         | 95%               |
| TREATMENT 4 | 15                         | 75%               |
| TREATMENT 5 | 20                         | 100%              |

Table 4.2 shows that Treatment 1 obtained the mortality of 0%, followed by Treatment 4 with a mortality of 75 %, Treatment 2 with a mortality of 85%. Treatment 3 (60% Ginger extract + 20 % citronella extract + 20% distilled water) with a mortality of 95% got the highest effectiveness among the organic treatments. Chemical treatment had a mortality of 100%.

**Table 4.3** Cost Analysis of organic treatment

| ITEM            | COST       |
|-----------------|------------|
| GINGER          | Php 36.00  |
| CITRONELLA      | Php 340.00 |
| 750 mL BOTTLE   | Php 200.00 |
| Distilled Water | Php 4.50   |
| Labor Cost      | Php 19.50  |
| TOTAL           | Php 600.00 |

Commercial Treatment – P    150.00

## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Conclusion**

Based on the data gathered and after testing the mortality rate, the researchers therefore concluded that Citronella grass and Ginger are effective materials for organic termite exterminator. Treatment 3 (60% Ginger 20% Citronella grass and 20% of distilled water) is the most effective ratio to kill termites among the organic treatments. In comparison, Chemical treatment is 5% more efficient than the organic treatment through mortality rate. The researchers further concluded that the organic termite exterminator is expensive than the commercial termite exterminator. The higher the concentration of ginger, the more it is effective.

#### **5.2 Recommendations**

The researchers recommend the following based on the results of the study:

1. Use citronella oil than citronella extract.
2. Use treatment with higher concentration of ginger, preferably of 80% or more.
3. Use another test such as mass loss and survival rate.
4. Make a study of citronella grass and ginger as wood preservative.

## **GLOSSARY OF TECHNICAL TERMS**

**Efficacy** – the power to produce a desired result or effect.

**Cardamom** – the seeds of an Asian plant that are used as a spice in cooking and baking.

**Citronella** – an oil that smells somewhat like lemons and that is used in candles, lamps, etc., to keep bugs away.

**Chlorpyrifos** – a toxic crystalline organophosphate pesticide that is used to control insect pests and ticks.

**Extract-** to pull something out, using force

**Mortality-** loss of life

**Mortality Rate-** the number of deaths that occur at a specific time, in specific group, or from a specific cause

**Rhizomes-** a continuously growing horizontal underground stem that puts out lateral shoots and adventitious roots at intervals

**Stalks-** a plant stem; the main stem or axis of a plant that is fleshy rather than woody

**Termiticide-** product that is known for killing of termites

**Turmeric** – the boiled, dried, and usually ground rhizome of the turmeric plant used as a coloring agent, a flavoring, or a stimulant.

## RESEARCH WORKPLAN

| Activities                                       | November |        |        |        | December |        |        |        | January |        |        |        | February |        |        |        | March  |        |        |        | April  |        |        |        | May    |        |        |        | June   |        |        |        | July   |        |        |        | August |        |        |        | September |  |  |  | October |  |  |  |
|--------------------------------------------------|----------|--------|--------|--------|----------|--------|--------|--------|---------|--------|--------|--------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|--|--|--|---------|--|--|--|
|                                                  | W<br>1   | W<br>2 | W<br>3 | W<br>4 | W<br>1   | W<br>2 | W<br>3 | W<br>4 | w<br>1  | w<br>2 | w<br>3 | w<br>4 | w<br>1   | w<br>2 | w<br>3 | w<br>4 | w<br>1 | w<br>2 | w<br>3 | w<br>4 | w<br>1 | w<br>2 | w<br>3 | w<br>4 | w<br>1 | w<br>2 | w<br>3 | w<br>4 | w<br>1 | w<br>2 | w<br>3 | w<br>4 | w<br>1 | w<br>2 | w<br>3 | w<br>4 | w<br>1 | w<br>2 | w<br>3 | w<br>4 |           |  |  |  |         |  |  |  |
| Research Title Selection                         |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Writing article review/critique                  |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Writing the introduction                         |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Writing the materials and methods                |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Proposal Preparation                             |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Research Planning                                |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Proposal Defense                                 |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Revision of the manuscript                       |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Preparing the termite killer treatment and tools |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Comparison of mortality rate and cost            |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Result evaluation                                |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Preparation for Final Defense                    |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Final Defense                                    |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Revision of the final manuscript                 |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |
| Submission of the final manuscript               |          |        |        |        |          |        |        |        |         |        |        |        |          |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |           |  |  |  |         |  |  |  |

## CURRICULUM VITAE

### **Latonio, Raymund Benz Daculap**

Brgy. San Pedro, Puerto Princesa City

0910 – 685 – 2143

raymund.latonio@gmail.com



### **PERSONAL DETAILS:**

|                |                                                     |
|----------------|-----------------------------------------------------|
| Date of Birth: | February 11, 1998                                   |
| Place of Birth | San Pedro, Puerto Princesa City                     |
| Weight         | 52 kg                                               |
| Height         | 5'8"                                                |
| Sex            | Male                                                |
| Religion       | Roman Catholic                                      |
| Civil Status   | Single                                              |
| Parents        | Mrs. Mercedes D. Latonio<br>Mr. Dionisio M. Latonio |

### **EDUCATIONAL ATTAINMENT:**

|            |                                                                                                                                |
|------------|--------------------------------------------------------------------------------------------------------------------------------|
| Tertiary   | Bachelor of Science in Civil Engineering<br>Palawan State University<br>Tinguiban Heights, Puerto Princesa City<br>2014 – 2018 |
| Secondary  | Fulbright College Integrated School<br>Rizal Ave., Brgy. Banca-Banca, Puerto Princesa City<br>2010 – 2014                      |
| Elementary | East Central School<br>H. Mendoza, Brgy. Model, Puerto Princesa City<br>2004 – 2010                                            |

## CURRICULUM VITAE

### **Morota, Reeve Adam Perez**

Brgy. San Pedro, Puerto Princesa City

0948 – 132 – 8997

reevemorota@yahoo.com



### **PERSONAL DETAILS:**

|                |                                                     |
|----------------|-----------------------------------------------------|
| Date of Birth: | February 24, 1998                                   |
| Place of Birth | San Pedro, Puerto Princesa City                     |
| Weight         | 59 kg                                               |
| Height         | 5'8"                                                |
| Sex            | Male                                                |
| Religion       | Roman Catholic                                      |
| Civil Status   | Single                                              |
| Parents        | Mrs. Carmencita P. Morota<br>Mr. Reynaldo N. Morota |

### **EDUCATIONAL ATTAINMENT:**

|            |                                                                                                                                |
|------------|--------------------------------------------------------------------------------------------------------------------------------|
| Tertiary   | Bachelor of Science in Civil Engineering<br>Palawan State University<br>Tinguiban Heights, Puerto Princesa City<br>2014 – 2018 |
| Secondary  | Life College<br>Rafols Ground, Junction 2 Brgy. San Pedro, Puerto<br>Princesa City<br>2010 – 2014                              |
| Elementary | San Pedro Central School<br>National Highway Brgy. San Pedro, Puerto Princesa City<br>2004 – 2010                              |

## CURRICULUM VITAE

### **Sempron, Liezel Cervantes**

Brgy. Santa Monica, Puerto Princesa City

0926 – 405 – 4145

liezelsempron05@gmail.com



### **PERSONAL DETAILS:**

|                |                                                        |
|----------------|--------------------------------------------------------|
| Date of Birth: | January 14, 1998                                       |
| Place of Birth | Puerto Princesa City                                   |
| Weight         | 49 kg                                                  |
| Height         | 5'2"                                                   |
| Sex            | Female                                                 |
| Religion       | Roman Catholic                                         |
| Civil Status   | Single                                                 |
| Parents        | Mrs. Jennybith C. Sempron<br>Mr. Lowell Ian C. Sempron |

### **EDUCATIONAL ATTAINMENT:**

|            |                                                                                                                                                                                            |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tertiary   | Bachelor of Science in Civil Engineering<br>Palawan State University<br>Tiniguiban Heights, Puerto Princesa City<br>2014 – 2018                                                            |
| Secondary  | Puerto Princesa City National Science High School<br>Tiniguiban Heights, Puerto Princesa City<br>2010 – 2014                                                                               |
| Elementary | Puerto Princesa Pilot Elementary School<br>Brgy. Kalipay, Roxas St., Puerto Princesa City<br>2009-2010<br>Liberato Damian Elementary School<br>Brgy. Sto. Tomas, Pasig City<br>2004 – 2009 |

## CURRICULUM VITAE

**Alulod, Camela Diana Amil**

Brgy. San Pedro, Puerto Princesa City

0912 – 736 – 3393

camelaalulod@gmail.com



### PERSONAL DETAILS:

|                |                                                |
|----------------|------------------------------------------------|
| Date of Birth: | October 31, 1997                               |
| Place of Birth | Bataraza, Palawan                              |
| Weight         | 45kg                                           |
| Height         | 5'                                             |
| Sex            | Female                                         |
| Religion       | Islam                                          |
| Civil Status   | Single                                         |
| Parents        | Mrs. Norma A. Alulod<br>Mr. Benjamin P. Alulod |

### EDUCATIONAL ATTAINMENT:

|            |                                                                                                                                |
|------------|--------------------------------------------------------------------------------------------------------------------------------|
| Tertiary   | Bachelor of Science in Civil Engineering<br>Palawan State University<br>Tinguiban Heights, Puerto Princesa City<br>2014 – 2018 |
| Secondary  | Palawan National School<br>H. Mendoza, Puerto Princesa City<br>2010 – 2014                                                     |
| Elementary | Puerto Princesa Pilot Elementary School<br>Brgy. Kalipay, Roxas St., Puerto Princesa City<br>2004 – 2010                       |



## REFERENCES

- Abin, J. S., Pestaño, R. A., Veranda, C. I., & Villacruz, R. P. (2016). Effectivity of Tuba-Tuba (*Jatropha Curcas* L.) Leaves Extract as Termites Killer. ii.
- Ajaiyeoba, E. O. (2002). Phytochemical and antibacterial properties of *Parkia biglobosa* and *Parkia bicolor* leaf extracts. *Afr. J. Biomed.* , 125-129.
- Behrens, R. (1996). *Cashew as an agroforestry crop*. Wiekersheim, Germany: Margaf Verlag.
- Boldt, E. (2015, March 16). *Dr. Axe Food and Medicine*. Retrieved from <http://www.draxe.com>
- Campbell, J. C. (2017). Subterranean Termite.
- Doydora, R. G., Lagrada, J. F., & Sapitula, J. A. (2017). *Jatropha Curcass* Linn (Tuba-tuba) Leaves and Fruits Extract as Termiticide. ii.
- Eiseman, Charley, Noah, Charney, & Carlson. (2010). *Tracks & Sign of Insects & other Invertebrates: Guide to North American Species*.
- Femi-Ola et al. (2008). Chemical composition and Termiticidal properties of *Parkia biglobosa*. (*Jacq*) *Benth. J. Bio. Sci*, 494-497.
- Herbalist of MDidea Extracts Professional. (2014, April 17). *Lemongrass, also known as Capimcidrao, Fever Tea, Melissa Grass, and Sereh, is Native to tropical Southeast Asia*.
- Hochkompturei. (2014, May 11). Retrieved from <https://bildungsburgertum.wordpress.com/2014/05/11/lemongrass/>
- Jummie. (2014, February 23). *Prezi*. Retrieved from <https://prezi.com/xc0fzhuix8mr/zingiber-extract-as-an-alternative-termotoide-buster/>

- Kamble, K. J., N., J. T., S., P. S., & A., A. S. (2017). Development of Cashewnut Shell Liquid based Termiticides by using Chemicals. *International Journal of Engineering Technology Science and Research*, 1082-1090.
- Mahadevappa, H., Kempaiah, K., Martin, S. S., & Girish, K. S. (2012). Emerging Roles of Anacardic Acid and its Derivatives: A Pharmacological Overview. *Basic & Clinical Pharmacology & Toxicology, Nordic Pharmacological Society*, 110(2), 122-132.
- Man, T. (2014, December 19). *How to get rid of lizards?* Retrieved from Twilight Zone.
- Masabni, D., & Lillard, P. (n.d.). *Texas A&M Agrilife Extension*. Retrieved from <https://aggie-horticulture.tamu.edu/vegetable/guides/specialty-vegetables/ginger/>
- Massey Services Inc. (2017, July 06). Retrieved from <https://www.masseyservices.com/hungry-drywood-termites/>
- Raptis, L. (2005, September 11). *BugGuide*. Retrieved from <https://bugguide.net/node/view/31160>
- Rose, J. (2017, April 30). *Citronella Grass ~ a Plant Profile*. Retrieved from Jean Rose Aromatherapy Blog.
- Shanker, C., & Dhyani, S. (2006). Insect pests of *Jatropha curcass* L. and the potentials for their management. *Current Science*, 359-360.
- Shukla, Y., Rani, A., Tripathy, A., & Sharma, S. (2006). Anti-feedant Activity of Ursolic acid isolated from *Duboisia myoporoides*. *Phytotherapy Research*, 162-163.
- Steven Foster. (2016, November 30). *National Center for Complementary and Integrative Health*. Retrieved from <https://nccih.nih.gov/health/ginger>

- Teklehaimanot, Z. (2004). Exploring the potential of indigenous agroforestry trees: *Parkia biglobosa* and *Vitellaria paradoxa* in sub-Saharan African Agrofor. Sys. 61-62.
- Tyman, J. H. (1979). Long chain phenols part VIII. Quantitative analysis of the unsaturated constituents of phenolic lipids by thin layer chromatography-mass spectrometry. *J. Chromatogra.*(136), 289-300.