EFFECT OF KAOLIN APPLICATON TIME INTERVALS ON HOST-FINDING BEHAVIOR AND OVIPOSITION OF *Diaphorina Citri*

UNDERGRADUATE THESIS

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YOGYAKARTA
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THESIS

Submitted to the Agrotechnology Study Program Faculty of Agriculture National Development University "Veteran" Yogyakarta to Fulfil Part of the Requirements for Obtaining Degree of Bachelor of Agriculture

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STATEMENT

I hereby declare that this undergraduate thesis entitled "Effect of Kaolin Application Time Intervals on Host-Finding Behavior and Oviposition of *Diaphorina citri*" is the result of my own research and that it does not contain any work that has been submitted by another person to obtain an undergraduate degree, either at Universitas Pembangunan Nasional "Veteran" Yogyakarta or at any other higher education institution. I also declare that this thesis does not contain any work or opinions that have been written or published by others, except those that are properly cited in the text and listed in the references. If this declaration is proven to be untrue, I am willing to accept sanctions in accordance with the applicable regulations.

Yogyakarta, January 2026

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EFFECT OF KAOLIN APPLICATON TIME INTERVALS ON HOST-FINDING BEHAVIOR AND OVIPOSITION OF *Diaphorina Citri*

By: Maika Filiana

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ABSTRACT

Diaphorina citri, as the main vector of Huanglongbing (HLB), can be controlled using kaolin as a particle film that disrupts insect behavior. This study aimed to determine the effect of kaolin application intervals on the biological responses of *D. citri*, including host-finding behavior and oviposition, as well as their effects on citrus shoot growth. The study was arranged in a Completely Randomized Design (CRD) consisting of non-choice tests, choice tests, and observations of shoot growth. In the non-choice test, citrus plants were treated with kaolin application intervals of 5, 10, and 15 days. The responses of *D. citri* were evaluated based on the number of individuals on leaves and shoots, the number of eggs, the number of nymphs, and changes in the presence of *D. citri* during the observation period. The choice test was conducted to determine *D. citri* preference for treated plants through observations at 20, 40, and 60 minutes, with six replications, using parameters of the number of psyllids moving toward treated and untreated leaves and the number of immobile psyllids. The effect of kaolin application on citrus plant growth was observed through shoot length, number of leaves, and leaf length, with data analyzed using ANOVA and DMRT at the 5% significance level. The results showed that kaolin application intervals significantly affected the biological responses of *Diaphorina citri*. Kaolin application every 5 days significantly reduced the number of *D. citri* on leaves and shoots, as well as the number of eggs and nymphs, making it the most effective interval in suppressing host-finding behavior and oviposition. Therefore, a 5-day kaolin application interval is the most effective for controlling *D. citri*, although its effects on citrus shoot growth should be considered, indicating the need to balance pest control effectiveness and plant growth.

Keywords: *Diaphorina citri*, kaolin, *Huanglongbing*, application interval, biological response, shoot growth.

BIOGRAPHY

The author, Maika Filiana, was born in Kebumen. She is the first child of Mr. Sukirman and Mrs. Sarmini (late), who passed away in 2014, and has one younger sibling named Agista Dwi Aulia.

The author began her formal education in 2007 at SDN 2 Bonjokkidul, then continued her education at SMPN 1 Prembun in 2013. She completed her senior high school education at SMAN 1 Kutowinangun and graduated in 2020.

In 2021, the author was admitted as an undergraduate student in the Agrotechnology Study Program, Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" Yogyakarta. During her study period, the author actively participated in various student activities and organizations. She was involved in the Agrotechnology Student Association and had served as a Division Head. In addition, she actively participated in student cadre development activities within the university environment.

The preparation of the undergraduate thesis entitled "Effect of Kaolin Application Time Intervals on Host-Finding Behavior and Oviposition of *Diaphorina citri*" was conducted as one of the requirements to obtain the Bachelor of Agriculture degree (S.P.) in the Agrotechnology Study Program, Faculty of Agriculture. The author hopes that this scientific work will be beneficial to readers and contribute to the development of agricultural science, particularly in the field of agrotechnology.

PREFACE

All praise and gratitude are due to Allah SWT for His blessings, guidance, and strength, which enabled the author to complete this undergraduate thesis entitled "Effect of Kaolin Application Time Intervals on Host-Finding Behavior and Oviposition of *Diaphorina citri"* Moreover, the author would like to express her sincere gratitude for the direction, advice, and valuable input in preparing this thesis to:

1. Dr. Ir. Mofit Eko Poerwanto, M.P., as the thesis supervisor, for his guidance, advice, and support throughout the completion of this thesis.
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The author also extends her gratitude to friends who supported her academic activities, as well as to all lecturers and academic staff who shared their knowledge and insights throughout her studies. The author hopes that the results of this research will be beneficial and useful for many people. May Allah SWT always provide guidance along this journey.

Yogyakarta, December 2025

The Author

TABLE OF CONTENTS

LIST OF TABLES

DAFTAR GAMBAR

LIST OF APPENDIX

CHAPTER I

INTRODUCTION

A. Background

Diaphorina citri, commonly known as the Asian citrus psyllid, is an important pest of citrus plants and serves as a vector of the pathogen causing Huanglongbing (HLB), also known as Citrus Vein Phloem Degeneration (CVPD). This disease can result in significant economic losses for citrus growers worldwide. Therefore, controlling this pest is crucial in efforts to maintain citrus productivity.

The damage caused by HLB infection includes plant decline and death, leading to reduced citrus production. For instance, according to Dwiastuti (2000), CVPD infestation in North Bali resulted in a decrease in citrus production of up to 60%. In 2012, CVPD incidence in Bangli Regency, Bali reached 54.38% with a disease intensity of 9.86% (Swari *et al.,* 2014). The spread of CVPD in Bali was largely attributed to the use of uncertified disease-free planting materials, which accounted for up to 83% (Wirawan *et al.,* 2003). Furthermore, the expansion of CVPD-affected areas in Bali from April to September 2009 ranged between 20% and 29% (Wijaya *et al.,* 2010). National citrus harvested area in 2011 was 47.181 thousand hectares, which declined to 46.187 thousand hectares in the following year and gradually increased to 48.119 thousand hectares by 2015. Overall, during this period, citrus production experienced a general decline of 5.83% (BPS and Directorate General of Horticulture, 2015).

Various control methods have been implemented, including chemical and ecological approaches. However, the use of certain chemical pesticides often results in negative impacts on the environment and human health. Consequently, the search for more environmentally friendly alternatives has become increasingly urgent. One promising method is the use of kaolin, a natural mineral that has been shown to effectively control pests by disrupting their feeding and reproductive activities.

The application of kaolin in agriculture is not only intended to reduce pest populations but also has the potential to enhance plant health through positive effects on plant physiology and biological responses. This study aims to explore the effects of kaolin application on *Diaphorina citri* and to understand the mechanisms by which kaolin influences the biological responses of this pest. Through this research, it is expected to provide new insights into the sustainable management of *D. citri* and to support environmentally friendly and efficient agricultural practices.

B. Problem Statement

1. Does the interval of kaolin application affect the host-finding behavior of *Diaphorina citri*?
2. Does the interval of kaolin application affect the oviposition behavior of *Diaphorina citri*?

3. What is the optimal kaolin application interval for controlling *Diaphorina citri*?

C. Reseach Aim

1. To determine the effect of kaolin application intervals on the host-finding behavior of *Diaphorina citri*.
2. To determine the effect of kaolin application intervals on the oviposition behavior of *Diaphorina citri*.
3. To determine the optimal kaolin application interval for controlling *Diaphorina citri*.

D. Significance

1. This study was conducted as a mandatory requirement to fulfill the undergraduate program in Agrotechnology at the Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" Yogyakarta.
2. The results of this study provide insights that may serve as a reference for developing effective pest management strategies for citrus crop protection.
3. This research identifies the most appropriate kaolin application interval for controlling *Diaphorina citri*.
4. The findings of this study may be used as reference data for further research on the effectiveness of kaolin in suppressing *Diaphorina citri* populations.

CHAPTER II

LITERATURW RIVIEW

A. *Huanglongbin (HLB)*

Citrus (*Citrus* spp.) is a horticultural crop with high economic value for farmers. Huanglongbing (HLB) is classified as one of the most destructive diseases of citrus and represents a major constraint in the development and improvement of citrus production in Indonesia. HLB is caused by the bacterium *Candidatus Liberibacter asiaticum* (CLas). This bacterium inhabits the phloem tissue of citrus plants and induces general symptoms such as chlorosis or yellowing of leaf veins, dark green leaves that become rigid, and a reduction in leaf and fruit size. Disease spread can occur rapidly when infected citrus plants are present around citrus plantations (Patandjengi *et al.,* 2022).

Citrus Vein Phloem Degeneration (CVPD) can be transmitted through several pathways, including: (a) insect vectors, (b) budwood grafting, (c) infected planting materials, and (d) infected citrus twigs affected by CVPD. The main insect vector of CVPD is *Diaphorina citri* Kuw. (Homoptera: Psyllidae) (Ratu *et al.,* 2020). CVPD is transmitted by citrus psyllids carrying *Candidatus Liberibacter asiaticum* within their bodies, allowing the bacterium to enter citrus plant tissues when the psyllids feed on shoots or leaves (Poerwanto *et al.,* 2020).

The psyllids attack young shoots, buds, and young leaves. As a result of psyllid infestation, young shoots become curled and their growth is inhibited.

Severe infestations cause plant tissues to gradually dry and eventually die. Eggs are usually laid singly or in clusters on buds and young shoots. Psyllids are capable of producing 9 – 10 generations per year. In the field, high population densities are typically indicated by the presence of white, transparent, spiral-shaped secretions around shoots or leaves (Poerwanto *et al.,* 2020).

Plants infected with CVPD exhibit characteristic symptoms, including irregular yellow blotches on leaves, with similar patterns on both the upper and lower leaf surfaces. Premature leaf drop of mature leaves from branch tips may occur as an indication of root decay, mineral deficiency, and other physiological stresses. These symptoms can affect the entire plant, particularly when infection occurs after the reproductive stage. In young plants, infection causes slow shoot growth and leaves to emerge with a broom-like appearance. In severe cases, leaves become rigid, veins thicken and narrow, and the entire leaf turns yellow. Fruiting trees produce fewer fruits, most of which fall prematurely before reaching maturity (Wirawan *et al.,* 2004).

B. *Diaphorina citri*

Diaphorina citri is a major agricultural pest that attacks the young shoots of citrus plants, resulting in inhibited plant growth. In addition to its role as a pest, *D. citri* also serves as a vector of *Citrus Vein Phloem Degeneration* (CVPD). Its population dynamics are influenced by interactions among various factors, including natality, mortality, host plants, climate, and other insects that function as parasitoids, predators, or competitors. As a vector of CVPD, disease transmission is highly dependent on population density, exposure, and the characteristics of the pathogen within the insect body (Wijaya, 2003).

Figure 2.1 *Diaphorina Citri*
Sourch : Shigeru Kuwayama (1908)

The classification of *Diaphorina citri* according to Kalshoven (1981) is as follows:

Phylum : Arthropoda

Class : Insecta

Order : Homoptera

Family : Psyllidae

Genus : Diaphorina

Species : *Diaphorina citri* Kuw.

C. Biology of *Dhiaporina citri*

The insect *Diaphorina citri* undergoes paurometabolous metamorphosis, in which development occurs through the egg, nymph, and adult stages, without a pupal stage.

1. Eggs

The eggs are elongated and oval in shape, resembling an avocado, with a length of approximately 0.4 mm and a diameter of about 0.2 mm at the wider part. They are initially pale yellow in color and gradually change to bright yellow or orange as embryonic development progresses. At the basal end of the egg, there is a stalk-like structure that functions to anchor the egg to plant tissue. Eggs are laid on young leaf buds that are still folded and in the leaf axils. The incubation period required for the eggs to hatch is approximately 3 – 5 days (Roma *et al.,* 2019).

Figure 2.2 Eggs of *Diaphorina Citri*

Sourch : I W. Mudita dan R.L. Natonis (2011)

2. Nymphs

The nymphs of *Diaphorina citri* range in color from pale yellow to dark brown and possess wing pads. Nymphs are commonly found in large numbers on the undersides of leaves (EFSA, 2021). *Diaphorina citri* nymphs undergo five instars. The duration of the first instar is approximately 2 – 3 days, the second instar 1 – 2 days, the third instar 2 – 5 days, the fourth instar 2 – 3 days, and the fifth instar 4 – 5 days.

The size of each instar varies. The first instar measures approximately 0.25 – 0.32 mm in length and 0.15 – 0.18 mm in width. The second instar has a length of about 0.36 – 0.45 mm and a width of 0.16 – 0.32 mm. The third instar measures approximately 0.71 – 0.95 mm in length and 0.35 – 0.45 mm in width. The fourth instar has a length of about 0.97 – 1.16 mm and a width of 0.53 – 0.75 mm. The fifth instar measures approximately 1.43 – 1.83 mm in length and 0.92 – 1.07 mm in width (Roma *et al.,* 2019).

Figure 2.3 Nymphs of *D. Citri*

Figure 2.4 Nymphs Secretion

3. Imago

The adult stage (*imago*) is characterized by the fully developed wings, enabling the insect to fly or jump. Adult *Diaphorina citri* are grayish-brown in color, with the dorsal and lateral surfaces of the head (caput) ranging from light to dark brown. The eyes are dark red. The forewings are gray with brown spots. The abdomen is bluish-green and orange in color, while the legs are grayish-brown. Adult body length ranges from approximately 2 to 3 mm. During feeding, this insect typically adopts a tilted posture, forming an angled position relative to the plant surface (Wijaya *et al.,* 2014).

Gambar 2.5 Adult of *Diaphorina Citri*
Sourch : BSIP Jestro (2023)

D. Kaolin

Kaolin-based particle films have been widely recognized as effective tools for controlling arthropod pests, as kaolin is a fine, non-abrasive white aluminosilicate mineral that forms a mineral barrier on plant surfaces when sprayed. In addition, the use of kaolin has been shown to reduce populations of the Asian citrus psyllid (ACP) and is considered more compatible with biological control programs because it does not harm the natural enemies of *Diaphorina citri*. Particle film technology, which coats plant organs to reduce damage caused by insects, diseases, and abiotic stress while improving crop yield, has gained increasing attention over the past two decades. The application of clay- or calcium carbonate–based particle films has also been reported to provide benefits to plant physiology. For example, kaolin clay improves water-use efficiency in cape gooseberry plants under water stress and reduces transpiration while increasing chlorophyll content in bean leaves, as well as lowering canopy temperature in apple trees. Calcium carbonate particle films are also used to reduce light stress and modify photosynthetic rates (Goday *et al.,* 2018).

According to Eduardo *et al.* (2023), the use of processed kaolin presents a promising approach to reducing infestation and spread of *Diaphorina citri*. In the United States, monthly applications of kaolin at a concentration of 3% on citrus resulted in a 78% reduction in *D. citri* nymphs and a 69% reduction in adult populations. In Colombia, the application of kaolin at 5% led to approximately a 50% reduction in *D. citri* eggs, nymphs, and adults in citrus orchards. In Brazil, Miranda *et al.* (2018) demonstrated through mark–release–recapture techniques that preventive applications of kaolin at 3% reduced the presence of adult *D. citri* in orchards by approximately 90%. Using a similar approach, biweekly applications of kaolin at 2% were proven effective in protecting developing citrus orchards against *D. citri*. Furthermore, kaolin application increased the reflectance of citrus leaves, which may interfere with the ability of *D. citri* to locate host plants (Miranda, Eduardo *et al.,* 2021).

Figure 2.6 Australian Kaolin *Surround* WP *Crop_Protectant*

E. Frame of Thoughts

Diaphorina citri is an important agricultural pest that attacks young shoots of citrus plants, resulting in inhibited plant growth. In addition to its role as a pest, *D. citri* serves as a vector of Citrus Vein Phloem Degeneration (CVPD). Its population dynamics are influenced by interactions among various factors, including natality, mortality, host plants, climate, and other insects acting as parasitoids, predators, or competitors. As a vector of CVPD, disease transmission is highly dependent on population density, dispersal, and the characteristics of the pathogen within the insect body (Wijaya, 2003).

Current control strategies still rely heavily on insecticides and the eradication of alternative host plants such as *Murraya paniculata*, while HLB management is conducted through the removal of infected plants and the planting of disease-free citrus seedlings. These efforts are only able to reduce attack intensity and delay outbreaks. On the other hand, the use of insecticides may lead to pest resistance, resurgence, outbreaks of secondary pests, and environmental pollution due to chemical residues. Therefore, the implementation of safer and more sustainable biological control strategies is essential.

Reducing *D. citri* populations can be achieved by altering host-finding behavior and oviposition activity. *Diaphorina citri* locates host plants for feeding and oviposition (i.e., citrus plants) through olfactory and visual cues. When citrus plants are coated with a layer that restricts the release of attractant compounds and exerts toxic effects on insects, host recognition becomes more difficult. According to Wicaksono and Endarto (2019), kaolin forms a particle film on leaves and fruits that disrupts feeding behavior and causes intoxication in pests. Kaolin particle films may also cause irritation, act as a physical barrier, and confuse insects attempting to feed or oviposit (Wicaksono and Endarto, 2019). Based on this theory, kaolin can be utilized as a control strategy against *D. citri* on citrus plants.

Previous studies have demonstrated that kaolin is a promising treatment for effectively managing *D. citri* infestations. Kaolin particle films provide additional benefits by disrupting landing, settling behavior, and feeding patterns of *D. citri*. Eduardo *et al.* (2021) reported that in the United States, monthly applications of kaolin at a concentration of 3% on citrus resulted in a 78% reduction in *D. citri* nymphs and a 69% reduction in adult populations. In Brazil, using mark–release–recapture techniques, preventive applications of kaolin at 3% reduced adult *D. citri* populations in orchards by approximately 90%. Similarly, biweekly applications of kaolin at 2% were effective in protecting developing citrus orchards from *D. citri*.

In general, plants treated with kaolin or insecticides showed an average reduction of 70% in *Diaphorina citri* eggs, 75% in nymphs, and 80% in adults compared with untreated control plants. Furthermore, no significant differences were observed between plants treated with two kaolin concentrations and those treated with insecticides during the experimental period. In all cases, plants treated with 5% kaolin showed an effectiveness of 95% against adult populations, compared with 90% for synthetic chemical insecticides and 85% for 2.5% kaolin. Application of 5% kaolin on leaves also showed comparable effectiveness (90%) against nymph populations, compared with insecticides (88%) and 2.5% kaolin (83%). A similar trend was observed for egg populations, with 5% kaolin spray achieving 90% effectiveness, synthetic insecticides 85%, and 2.5% kaolin 80%. Thus, the most effective treatment for controlling various developmental stages of *Trialeurodes vaporariorum* was 5% kaolin, followed by chemical insecticides and 2.5% kaolin (Nuñez-López *et al.,* 2015). Therefore, a kaolin concentration of 5% was selected for use in this study.

Various pest control methods have been applied, including chemical and ecological approaches. However, the use of certain chemical pesticides often results in negative impacts on the environment and human health. Consequently, the search for more environmentally friendly alternatives has become increasingly urgent. One promising approach is the use of kaolin, a natural mineral proven effective in pest control by disrupting feeding activity and reproduction.

The application of kaolin in agriculture is not only intended to reduce pest populations but also has the potential to improve plant health through positive effects on plant physiology and biological responses. This study aims to explore the effects of kaolin application on *Diaphorina citri* and to understand the mechanisms by which kaolin influences the biological responses of this pest. Through this research, it is expected to provide new insights into sustainable *D. citri* management and to support environmentally friendly and efficient agricultural practices**.**

F. Hypothesis

The application of 5% kaolin at 5-day intervals over a one-month period is hypothesized to be the most effective treatment in influencing host-finding behavior and oviposition of *D. citri*, thereby reducing *D. citri* populations.

CHAPTER III

RESEARCH METHOD

A. Place and Time Research

This study was conducted at the Plant Protection Laboratory and the Experimental Garden of the Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" Yogyakarta, located in Sleman Regency, Special Region of Yogyakarta, Indonesia. The experiment was arranged using a Completely Randomized Design (CRD). The study was carried out from February to April 2025.

B. Material, Tools and Method

1. Material

The materials that were used for the research are orange jasmine plant (Murraya paniculata), citrus plant, Australia kaolin is (*Surround® WP* crop protectant) with the specification is 325 mesh or 0,044mm, made from kaolin clay (white clay) and edible mineral. This kaolin is available as a wettable powder that can be mixed with water for application. Australia kaolin has CAS Number 92704-41-1 and concentration (%w/w) is 95 with details of manufacturer or importer is AgNova Technologies Pty Ltd Unit 4, 482 Kingsford Smith Drive Hamilton Qld 4007 Australia (03) 9899 8100 agnova.com.au, Diaphorina citri, distilled water and NPK 16:16:16.

2. Tools

Tools that were used for the research are rectangular cages (72×72×93cm) made from tile fabric and PVC pipes, 1000ml pressure prayer, insect net, insect aspirator, digital scales, pipet, water drum, handphone and stationery.

3. Method

The methods used in this study to determine host-finding behavior and oviposition consisted of choice and non-choice tests using a Y-tube olfactometer, arranged in a Completely Randomized Design (CRD). Each treatment was conducted over a period of 30 days with five **replications**. The treatments were as follows:

Kontrol	: Sprayed with distilled water
K5H	: Sprayed with 5% kaolin every 5 days
K10H	: Sprayed with 5% kaolin every 10 days
K15H	: Sprayed with 5% kaolin every 15 days

C. Research Implementation

1. Rearing of *Diaphorina citri*

The *Diaphorina citri* specimens used in this study were obtained from the Indonesian Citrus and Subtropical Crops Research Institute (BPSI Jestro), Malang, East Java. The rearing of *D. citri* was conducted in cages containing orange jasmine (*Murraya paniculata*) plants measuring 72 cm in length, 72 cm in width, and 92 cm in height. The orange jasmine plants, sourced from the Experimental Garden of the Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" Yogyakarta, served as alternative host plants. To facilitate the reproductive cycle of *D. citri*, small transparent tubes were placed over young shoots of the orange jasmine plants. Male and female *D. citri* were introduced into these tubes to facilitate mating.

2. Maintenance of orange jasmine

Orange jasmine plants were cultivated in pots measuring 25 cm × 25 cm and maintained inside cages measuring 72 cm × 72 cm × 92 cm. Trays filled with water were placed beneath the plants to prevent ants from accessing the plants. Plant maintenance included watering, pruning, fertilization, weeding, leaf cleaning, and plant replacement. Watering was carried out once daily. Pruning was conducted to stimulate the growth of new shoots. Fertilization was applied to ensure adequate nutrient availability for the plants. Weeding was performed manually when weeds appeared around the plants. Leaf debris was removed by spraying the leaves with water and gently wiping them with tissue paper. Orange jasmine plants were routinely replaced when excessive leaf drop occurred, fungal infection was observed, or when the plants failed to produce new shoots.

3. Maintenance of Citrus Plants

Citrus plants were cultivated in pots measuring 25 cm × 20 cm. Routine maintenance included daily watering, pruning to stimulate the development of new shoots, fertilization, and weeding to prevent nutrient competition with other plants. In addition, branches were pruned to encourage shoot emergence, followed by exposure and supplementary fertilization. The citrus plants were subsequently placed inside a greenhouse.

4. Formulation of 5% Australian Kaolin (*Surround* WP)

The kaolin concentration used in this study was 5%, prepared by mixing kaolin with water. The formulation process involved dissolving 15 g of kaolin in 285 mL of water to obtain a 5% kaolin solution. The volume of the solution was measured before and after application to determine the amount of solution applied to the plants. A 1,000 mL pressure sprayer was used for kaolin application.

Figure 3.1 Preparation of Kaolin Solution

5. Application of Kaolin to Plants

Kaolin was applied by spraying a single plant thoroughly until the spray reached the point of initial runoff from the leaf surface. Each plant was treated with Surround WP kaolin at a concentration of 5% (15 g kaolin + 285 mL water). The volume of the spray solution was measured before and after application to determine the amount of solution applied to each plant. A 1,000 mL pressure sprayer was used for kaolin application

Figure 3.2 Application of Kaolin

6. Non-choice Test

The non-choice test was used to determine feeding behavior and oviposition behavior. This test was conducted in a plant protection greenhouse located at the Experimental Garden of the Faculty of Agriculture, Universitas Pembangunan Nasional "Veteran" Yogyakarta. The non-choice test was carried out using a rectangular cage measuring 72 cm × 72 cm × 92 cm. The cage was constructed from fine mesh (tulle fabric) supported by PVC pipes according to the cage dimensions.

The non-choice test was conducted by placing a treated citrus plant with a pruned stem and five young shoots inside the cage. A tube containing 25 adult *Diaphorina citri* (aged 14 – 47 days), consisting of 15 females and 10 males, was then placed inside the cage, allowing the psyllids to freely exit the tube. Kaolin was applied by spraying the plant until all plant parts were completely covered. After application, the plants were left for approximately 1 hour to allow the kaolin solution to dry.

For subsequent applications, the cage zipper was slightly opened to insert the pressure sprayer and reapply the kaolin solution to the plant. The zipper was immediately closed tightly after spraying to prevent *D. citri* from escaping the cage.

Observations were conducted every two days at 09:00 a.m. (WIB). Kaolin applications were carried out according to the assigned treatments and predetermined timeline. The non-choice test was performed with five replications. Once a week, 10 adult *D. citri* (5 females and 5 males) were released simultaneously into each treatment.

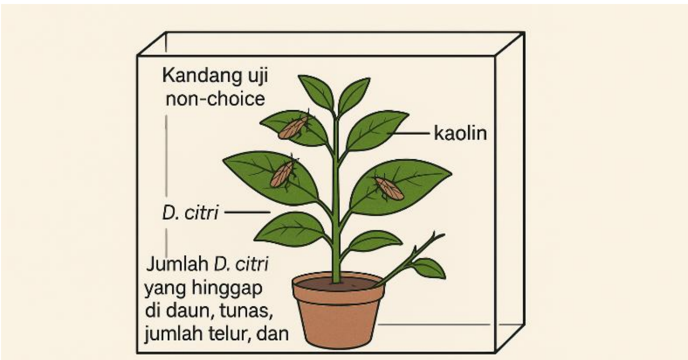

Figure 3.3 Illustration of the Non-choice Test

7. Choice Test

The choice test was conducted using a modified Y-tube olfactometer. This test was carried out at the Plant Protection Laboratory, Universitas Pembangunan Nasional "Veteran" Yogyakarta. The choice test aimed to confirm whether kaolin was able to inhibit volatile compounds emitted by citrus leaves, as *Diaphorina citri* is known to locate its host plants using volatile cues.

The choice test was performed using the treatment that produced the best results in the non-choice test, namely K5H. The selection of K5H for the choice test was based on its consistent performance in producing the lowest *D. citri* responses in the non-choice test across several key parameters. At each end of the Y-tube, two leaves that had been treated for one month were placed, with one end serving as the odor source.

Air was supplied from an aerator pump and first passed through distilled water in a small container to provide humidity, followed by activated charcoal in another container to neutralize the air. Airflow regulation during the choice test was controlled using an airflow meter set at a scale of 20, which represents the instrument scale and does not correspond to an absolute airflow velocity unit. The airflow was maintained at a constant level to ensure uniform testing conditions and to minimize the influence of environmental factors on *D. citri* behavior.

The air was then delivered through tubing to the odor sources, consisting of containers holding citrus leaves sprayed with kaolin every 5 days for 30 days and leaves sprayed with distilled water every 5 days for 30 days. The air carrying the odor cues was subsequently directed into the arms of the Y-tube.

The airflow meter regulated the airflow pressure at 20 mL min^{-1}. At the base of the Y-tube, 10 adult *Diaphorina citri* were released. Observations were conducted at 20, 40, and 60 minutes after the release of *D. citri*. The choice test was performed with six replications.

Figure 3.4 Choice Test

8. Test of the Effect of Kaolin on Shoot Growth

The best treatment from the non-choice test, consisting of a 5% kaolin application at 5-day intervals, was applied to evaluate its effect on shoot growth. The treatments consisted of spraying citrus shoots with 5% kaolin every 5 days, while shoots sprayed with distilled water every 5 days served as the control. Treatments were applied to shoots measuring 4–6 mm in length.

This test was conducted with six replications. Observations were carried out before the first application and subsequently every 5 days after application for a total period of 30 days, resulting in six observation data points for each image acquisition.

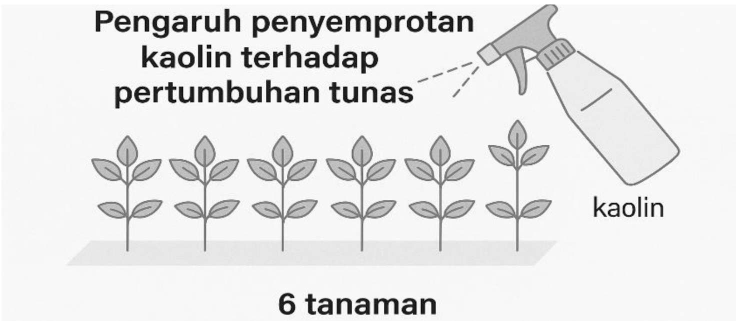

Figure 3.5 Illustration of the Effect of Kaolin on Shoot Growth

D. Observation Parameters

1. Non-choice test

   a. Number of psyllids on leaves

      This parameter was used to determine the host-finding behavior of *Diaphorina citri.* The number of psyllids recorded was the total number of *D. citri* individuals present on or attached to the leaves at the time of observation.

   b. Number of psyllids on shoots

      This parameter was used to evaluate the oviposition behavior of *D. citri*. The number of psyllids recorded was the total number of *D. citri* individuals present on or attached to the shoots at the time of observation

   c. Number of dead psyllids in the arena

      The number of dead *Diaphorina citri* individuals in the arena was determined by subtracting the number of *D. citri* found on leaves and shoots from the total number of individuals released into the cage. This parameter was used to calculate the repellency index of the applied treatments.

The **Repellency Index (RI)** was calculated using the formula proposed by Mazzonetto (2003):

$$\mathrm{IR} = \frac{2G}{G+P}$$

where:

G = number of insects present in the treated area

P = number of insects present in the untreated area

The RI values were classified as follows: **RI < 1** indicates a repellent effect, **RI = 1** indicates a neutral effect, and **RI > 1** indicates an attractant effect. The repellency index was calculated to determine whether kaolin acts as a repellent against.

d. Number of *D. citri* eggs

This parameter was used to assess the oviposition behavior of *D. citri*. The number of eggs recorded was the total number of eggs found on plant shoots at the time of observation. Egg observation and counting were conducted using a magnifying glass.

e. Number of *D. citri* nymphs

This parameter was used to evaluate the oviposition behavior of *D. citri*. The number of nymphs recorded was the total number of nymphs present on plant shoots at the time of observation.

2. Choice Test

The number of psyllids moving toward treated and untreated leaves was determined based on the number of *Diaphorina citri* individuals that moved toward the odor source within a distance of 1 cm. Observations were conducted at 20, 40, and 60 minutes after the psyllids were released.

3. Effect of Treatments on Shoot Growth

a. Shoot length

Shoot length was measured before the first treatment application and subsequently observed at 5-day intervals until the entire treatment period was completed.

b. Number of leaves

The number of leaves was counted from the time the shoots opened and leaf blades became visible until the completion of the treatment period, in order to monitor overall plant growth development.

c. Leaf length

Leaf length was measured from one leaf with the greatest length, serving as a representative of maximum leaf growth during the observation period.

E. Data Analysis

Data obtained from the non-choice test were analyzed using Analysis of Variance (ANOVA) at a 5% significance level. When significant differences were detected, further analysis was performed using *Duncan's Multiple Range*

Test (DMRT) at the same significance level to determine differences among treatments.

Meanwhile, data from the choice test and shoot growth observations were analyzed using a t-test at a 5% significance level. The t-test was used to compare the mean values of two treatment groups, namely the control and kaolin treatments, to determine whether there were statistically significant differences between the two groups.

CHAPTER IV

RESULT AND DISSCUSION

A. Result

1. Non-choice Test

a. Results for the Number of *Diaphorina citri* on Citrus Leaves

The observations conducted to determine the feeding behavior of *Diaphorina citri* were carried out by observing the number of psyllids on the leaves at the time of observation. The following are the results of the average observations of the number of psyllids on the leaves of citrus plants.

Table 4.1 Average Number of *Diaphorina citri* on Citrus Leaves Observed Every Two Days for Eight Observations Over 30 Days

Treatment	Control	K5H	K10H	K15H
Day 16	28,80 ± 1,55 a	2,60 ± 1,55 c	4,20 ± 1,55 c	11,60 ± 1,55 b
Day 18	26,20 ± 2,47 a	0,60 ± 2,47 b	3,40 ± 2,47 b	3,60 ± 2,47 b
Day 20	26,80 ± 2,38 a	0,60 ± 2,38 b	2,60 ± 2,38 b	1,80 ± 2,38 b
Day 22	25,60 ± 1,99 a	00,00 ± 1,99 b	0,20 ± 1,99 b	1,80 ± 1,99 b
Day 24	32,20 ± 2,30 a	2,60 ± 2,30 b	3,60 ± 2,30 b	6,40 ± 2,30 b
Day 26	30,00 ± 1,54 a	1,60 ± 1,54 c	4,20 ± 1,54 bc	5,80 ± 1,54 b
Day 28	30,80 ± 1,22 a	00,00 ± 1,22 d	3,40 ± 1,22 c	6,40 ± 1,22 b
Day 30	35,20 ± 1,63 a	1,00 ± 1,63 c	3,60 ± 1,63 c	7,20 ± 1,63
Mean	29,45 ± 2,09 a	1,13 ± 1,88 c	3,15 ± 1,86 b	5,58 ± 2,09 b

Notes:

- Numbers followed by the same letter in the same row indicate no significant difference based on the DMRT 5% level follow-up test.
- Control = no kaolin application; K5H = kaolin application every 5 days; K10H = kaolin application every 10 days; K15H = kaolin application every 15 days.

Based on the table of the mean number of *D. citri* on leaves, kaolin application at different spraying intervals had a significant effect on the number of *D. citri* on citrus leaves. Compared with the control, all three treatments (K5H, K10H, and K15H) reduced the *D. citri* population during the observation period. The 5-day spraying interval (K5H) showed the most consistent reduction, resulting in the lowest number of *D. citri*, with values reaching 0.00 individuals per leaf on the 22nd and 28th observation days, indicating that this treatment was the most effective in suppressing the presence of *D. citri*. The 10-day interval (K10H) also reduced the number of *D. citri*, although it was less effective than K5H, while the 15-day interval (K15H) remained lower than the control but showed higher values compared with the other two treatments.

b. Results for the Number of *Diaphorina citri* on Shoots

To observe oviposition behavior, the number of individuals found on citrus plant shoots can also be used as a main parameter. This is because female psyllids prefer young shoots as sites for egg laying. It is known that citrus shoots are the primary locations used by *D. citri* for oviposition. The following are the average numbers of psyllids observed on citrus shoots during the observation period.

Tabel 4.2 Average Number of *Diaphorina citri* on Citrus Shoots Observed Every Two Days for Eight Observations Over 30 Days
Notes:

Treatment	Control	K5H	K10H	K15H
Day 16	1,48 ± 0,33 a	0,91 ± 0,33 a	0,99 ± 0,33 a	1,29 ± 0,33 a
Day 18	1,76 ± 0,34 a	0,71 ± 0,34 b	1,23 ± 0,34 ab	0,99 ± 0,34 b
Day 20	1,22 ± 0,17 a	0,71 ± 0,17 b	0,81 ± 0,17 b	0,71 ± 0,17 b
Day 22	1,49 ± 0,26 a	0,71 ± 0,26 b	0,81 ± 0,26 b	0,81 ± 0,26 b
Day 24	1,43 ± 0,31 a	1,16 ± 0,31 a	1,02 ± 0,31 a	0,99 ± 0,31 a
Day 26	1,37 ± 0,27 a	0,91 ± 0,27 a	0,71 ± 0,27 a	1,09 ± 0,27 a
Day 28	1,14 ± 0,23 a	0,81 ± 0,23 a	0,71 ± 0,23 a	0,71 ± 0,23 a
Day 30	1,35 ± 0,31 a	0,71 ± 0,31 a	0,88 ± 0,31 a	1,94 ± 0,31 a
Mean	1,40 ± 0,20 a	0,84 ± 0,17 b	0,89 ± 0,18 b	1,19 ± 0,38 a

- Numbers followed by the same letter in the same row indicate no significant difference based on the DMRT 5% level follow-up test.
- Control = no kaolin application; K5H = kaolin application every 5 days; K10H = kaolin application every 10 days; K15H = kaolin application every 15 days.

Based on observations of the number of *D. citri* on citrus shoots over a 30-day period, kaolin application at different spraying intervals did not show significant differences at most observation times. However, on specific days, namely days 8, 18, 20, and 22, a reduction in the number of *D. citri* was observed in the K5H, K10H, and K15H treatments compared with the control. This indicates that kaolin application has the potential to reduce the number of *D. citri* settling on citrus shoots, particularly at certain periods following application. Nevertheless, temporal fluctuations in *D. citri* abundance were still observed, suggesting that kaolin effectiveness may be influenced by environmental factors as well as the persistence and adhesion of the material on the plant surface.

c. Repellency Index Results for Each Treatment

Table 4.3 Repellency index results for each treatment

Treatment	Average Psyllids		IR	Notation
	Treated	Arena/Die		
Kontrol	37	28	1,13	NR
K5H	1	64	0,03	R
K10H	4	61	0,12	R
K15H	7,8	57,2	0,24	R

Notes:

- R (Repellent) for repellency index values < 1, NR (Not Repellent) for repellency index values > 1, N (Neutral) for repellency index values = 1.
- Average data obtained from data on the number of *D. Citri* on leaves and shoots on the 30th day of observation.

Based on Table 4.3, the control showed a repellent index value of 1.13 with the notation NR, indicating that it did not provide a repellent effect on the presence of *D. citri*. In contrast, all treatments with kaolin spraying intervals (K5H, K10H, and K15H) resulted in repellent index values of less than 1, thus falling into the R (repellent) category. The K5H treatment had a repellent index value of 0.03, indicating the strongest repellent effect compared to the other treatments. The K10H treatment had a repellent index value of 0.12, while the K15H treatment had a value of 0.24. These results indicate that all three treatments were effective in reducing the presence of *D. citri,* with the highest effectiveness observed at the 5-day spraying interval (K5H). Therefore, the K5H treatment was used for further testing in this study, namely testing using a Y-tube olfactometer and evaluating its effect on plant growth.

d. Results for the Number of *Diaphorina citri* Eggs

To determine the oviposition activity of *Diaphorina citri*, the number of eggs present on citrus plant shoots was counted. The observation process was carried out manually with the aid of a magnifying glass to ensure data accuracy. All observations were conducted simultaneously to maintain data consistency among parameters. The following presents the average number of *D. citri* eggs found on citrus plant stems during the observation period.

Table 4.4 Average Number of *Diaphorina citri* Eggs Observed Every Two Days for Eight Observations Over 30 Days

Treatment	Control	K5H	K10H	K15H
Day 16	3,12 ± 0,46 a	0,71 ± 0,46 b	0,71 ± 0,46 b	0,71 ± 0,46 b
Day 18	2,14 ± 0,42 a	0,71 ± 0,42 b	0,71 ± 0,42 b	0,71 ± 0,42 b
Day 20	1,45 ± 0,35 a	0,71 ± 0,35 a	0,71 ± 0,35 a	0,71 ± 0,35 a
Day 22	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a
Day 24	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a
Day 26	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a
Day 28	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a
Day 30	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a	0,00 ± 0,00 a
Mean	0,84 ± 1,28 a	0,27 ± 0,29 a	0,27 ±0,29 a	0,27 ± 0,29 a

Noted:

- Numbers followed by the same letter in the same row indicate no significant difference based on the DMRT 5% level follow-up test.
- Control = no kaolin application; K5H = kaolin application every 5 days; K10H = kaolin application every 10 days; K15H = kaolin application every 15 days.

Based on observations of the number of *Diaphorina citri* eggs on citrus shoots over a 30-day period, oviposition activity was found to occur only until the 20th day of observation. Egg numbers tended to be higher in the control treatment compared with the kaolin-treated plants, particularly from day 12 to day 18, during which the K5H, K10H, and

K15H treatments showed significantly lower values than the control. This indicates that kaolin application was able to inhibit the oviposition activity of *D. citri* on citrus shoots. Overall, the number of eggs observed was relatively low or even absent, suggesting that the presence of kaolin on the plant surface reduced the attractiveness of the shoots for *D. citri* oviposition.

e. Results for the Number of *Diaphorina citri* Nymphs

The number of *Diaphorina citri* nymphs present on citrus plant shoots was observed to determine the development of the test insect population. Observations were carried out manually using a magnifying glass to ensure more accurate counts. This activity was conducted every two days for 30 days, coinciding with observations of other non-choice parameters to ensure consistency among parameters. All observations were performed at the same time throughout the research period. The following presents the average number of *D. citri* nymphs observed on citrus plant shoots during the observation period.

Table 4.5 Average Number of *Diaphorina citri* Nymphs Observed Every Two Days for Eight Observations Over 30 Days

Treatment	Control	K5H	K10H	K15H
Day 16	1,61 ± 0,46 a	0,71 ± 0,46 a	0,71 ± 0,46 a	0,71 ± 0,46 a
Day 18	1,67 ± 0,46 a	0,71 ± 0,46 a	0,71 ± 0,46 a	0,71 ± 0,46 a
Day 20	2,02 ± 0,54 a	0,71 ± 0,54 a	0,71 ± 0,54 a	0,71 ± 0,54 a
Day 22	1,72 ± 0,46 a	0,71 ± 0,46 a	0,71 ± 0,46 a	0,71 ± 0,46 a
Day 24	1,75 ± 0,45 a	0,71± 0,45 a	0,71 ± 0,45 a	0,71 ± 0,45 a
Day 26	1,58 ± 0,47 a	0,71 ± 0,47 a	0,71 ± 0,47 a	0,71 ± 0,47 a
Day 28	1,12 ± 0,28 a	0,71 ± 0,28 a	0,71 ± 0,28 a	0,71 ± 0,28 a
Day 30	0,81 ± 0,07 a	0,71 ± 0,07 a	0,71 ± 0,07 a	0,71 ± 0,07 a
Mean	1,54 ± 0,39 a	0,71 ± 0,00 a	0,71 ± 0,00 a	0,71 ± 0,00 a

Noted:

- Numbers followed by the same letter in the same row indicate no significant difference based on the DMRT 5% level follow-up test.
- Control = no kaolin application; K5H = kaolin application every 5 days; K10H = kaolin application every 10 days; K15H = kaolin application every 15 days.

Based on the observations of the number of *D. citri* nymphs on shoots over a 30-day period, it was found that the appearance of nymphs began to be observed on day 12 after application. In general, the number of nymphs in all treatments did not show significant differences based on the results of the DMRT test at the 5% level. However, the number of nymphs in the control treatment tended to be higher than in the kaolin treatments, especially during the period from day 14 to day 24. This condition indicates that kaolin application, although not providing statistically significant differences, showed a tendency to reduce the number of nymphs developing on citrus shoots. This is presumably due to the effect of the kaolin layer interfering with the egg-laying process and/or egg hatching of *D. citri,* thereby inhibiting nymph development on the plant surface.

2. **Choice Test**

The purpose of this test was to demonstrate that volatile compounds from citrus leaves could be inhibited by the applied treatment, thereby causing a repellent effect on *D. citri.*

Table 4.6 Average Number of *Diaphorina citri* Moving to Treated Leaves, Untreated Leaves, Tube Arms, and Remaining Inactive

Observation	Control	Kaolin
20 menit	0,33 a	1,00 a
40 menit	3,17 a	1,00 b
60 menit	4,83 a	0,83 b

Noted: Numbers followed by the same letter in the same row indicate no significant difference based on the t-test at the 5% significance level.

Based on the results of the choice test, the number of *Diaphorina citri* moving toward treated leaves showed different responses among treatments at several observation times. At the 20-minute observation, the number of *D. citri* recorded on kaolin-treated leaves (1.00 individual) was not significantly different from that on the control leaves (0.33 individuals). However, at the 40-minute observation, the number of *D. citri* on the control leaves (3.17 individuals) was significantly higher than that on the kaolin-treated leaves (1.00 individual) **($p < 0.05$)**. A similar pattern was observed at the 60-minute observation, where the number of *D. citri* on the control leaves (4.83 individuals) was significantly higher than that on the kaolin-treated leaves (0.83 individuals) **($p < 0.05$)**. These results indicate that kaolin application reduced the number of *D. citri* selecting and settling on treated leaves, suggesting a significant repellent effect of kaolin against *D. citri*.

3. **Effect of Treatment on Shoot Growth**

To determine the effect of the treatment on plant growth, an experiment was carried out using citrus plant shoots treated with the best treatment from the previous non-choice test. The treatment used was H5D, namely the application of 5% kaolin sprayed every five days, with six replications. Observations were conducted every five days.

Tabel 4.7 Mean of Shoot Length (mm)

Perlakuan	Day 0	Day 5	Day 10	Day 15	Day20	Day25	Day30
Kontrol	4,80 a	10,85 a	17,02 a	22,18 a	27,33 a	28,00 a	32,43 a
Kaolin	3,28 a	5,82 b	8,53 b	10,78 b	13,33 b	12,20 a	9,47 b

Noted: Numbers followed by the same letter in the same row indicate no significant difference based on the t-test at the 5% significance level.

Tabel 4.8 Mean Number of Leaves (sheet)

Perlakuan	Day 0	Day 5	Day 10	Day 15	Day 20	Day 25	Day 30
Kontrol	2,50 a	4,50 a	5,17 a	6,00 a	7,17 a	6,00 a	6,33 a
Kaolin	1,67 a	2,50 b	2,67 b	2,83 b	3,33 b	2,67 a	2,00 b

Noted: Numbers followed by the same letter in the same row indicate no significant difference based on the t-test at the 5% significance level.

Tabel 4.9 Mean of Leaf Length (mm)

Perlakuan	Day 0	Day 5	Day 10	Day 15	Day 20	Day 25	Day 30
Kontrol	10,33 a	22,88 a	35,63 a	46,30 a	57,77 a	58,48 a	71,43 a
Kaolin	6,50 a	11,82 b	16,27 b	21,17 b	25,10 b	22,32 b	18,63 b

Noted: Numbers followed by the same letter in the same row indicate no significant difference based on the t-test at the 5% significance level.

Based on observations of citrus shoot growth parameters, including shoot length, number of leaves, and leaf length, kaolin treatment had a significant effect on shoot growth. Across all observed parameters, control plants exhibited higher values than kaolin-treated plants from day 5 to day

30 after application. These differences were statistically significant at the 5% significance level ($p < 0.05$). The results indicate that kaolin application tended to suppress citrus shoot growth, as reflected by reduced shoot elongation, lower leaf number increment, and smaller leaf size. This suggests that kaolin application may influence plant physiological activities, resulting in a reduced growth rate of young citrus shoots.

B. Discussion

1. Non-Choice Test

The results of the non-choice test showed that kaolin application with different spraying intervals (K5H, K10H, and K15H) had a significant effect on the number of *Diaphorina citri* settling, ovipositing, and developing on citrus plants compared to the control. In general, all kaolin treatments were able to suppress the population of *D. citri* on both leaves and shoots; however, the highest effectiveness was obtained with the K5H treatment (spraying every five days). This indicates that more frequent applications result in a more stable kaolin layer on the surface of leaves and plant stems, thereby providing longer-lasting and more consistent protective effects against pest attacks.

The kaolin layer formed on the plant surface functions as both a physical and visual barrier for *D. citri.* The white color of this layer alters light reflection on the leaf surface, causing the natural green color of the plant, which usually attracts insects, to become less recognizable. As a result, *D. citri* has difficulty locating suitable hosts for settling or oviposition. According to Wicaksono & Endarto (2019), kaolin particles that form a thin white layer on the plant surface not only repel pests but also cause irritation, confusion, and act as a barrier when pests attempt to feed and lay eggs. This layer disrupts the insects' visual perception of leaf color and shape, thereby reducing their interest in landing or feeding. This effect was clearly observed in the present study, where the K5H treatment resulted in the lowest average number of *D. citri* on both leaves and shoots during the 30-day observation period.

In addition to disrupting the host-searching process, the kaolin layer was also proven to have a repellent effect on *D. citri.* The index repellent (IR) values in the K5H, K10H, and K15H treatments were <1, indicating a repellent effect against insect presence, with the lowest value observed in the K5H treatment at 0.03. In contrast, the control treatment showed an RI value of 1.13 (NR), indicating the absence of a repellent effect. These results strengthen the findings of Pierre *et al.* (2021), which reported that kaolin particles based on Surround WP function as a physical barrier capable of preventing insects from settling and sucking plant sap by altering the visual and tactile characteristics of the leaf surface.

Kaolin treatment also affected the oviposition activity of *D. citri.* Based on the observations, egg-laying activity was only detected up to day 20 of observation, and the number of eggs produced on control plants was much higher than on all kaolin-treated plants. The lowest number of eggs was found in the K5H treatment, followed by K10H and K15H. This indicates that kaolin not only inhibits insects from settling but also reduces the stimulation for female insects to lay eggs. This finding is consistent with the study conducted by Lapointe (2000), which concluded that oviposition activity can be suppressed or that no insect eggs are found on plants treated with kaolin. Glenn and Puterka (2005) explained that the kaolin layer can interfere with egg deposition on the leaf surface and create an unfavorable living environment for insects, ultimately affecting egg hatching success. Miranda *et al.* (2021) also emphasized that kaolin treatment can significantly reduce oviposition rates and the survival of *D. citri* because the layer limits direct contact between insects and plant tissues or disrupts *D. citri* behavior in locating suitable hosts.

The observations on the number of nymphs showed that nymph emergence began to be observed on day 12 after application, with the highest numbers occurring on control plants. Although no significant differences among treatments were detected, a decreasing trend in nymph populations was observed in all kaolin treatments, particularly in K5H and K10H. This is likely because the kaolin layer that remained on the shoot surface inhibited egg hatching and reduced the ability of nymphs to survive. According to Hall *et al*. (2007), the application of kaolin particles can reduce nymph populations by more than 50% compared to untreated plants, as these particles obstruct physical interactions and interfere with insect feeding activities.

Overall, the non-choice test results indicate that kaolin treatment with a five-day spraying interval (K5H) was the most effective method for suppressing *D. citri* populations on citrus plants. The kaolin layer acts physically by altering light reflection, masking the natural color of leaves, and creating a surface that is unfavorable to insects, thereby inhibiting host-searching processes, oviposition, and nymph development. These findings are consistent with the studies of Pierre *et al.* (2021) and Miranda *et al.* (2021), which concluded that fine particle–based kaolin is capable of reducing insect infestation through visual and tactile effects without causing toxic effects on plants.

2. Choice Test

The choice test was conducted to confirm that the host-seeking mechanism of *D. citri* relies on aromas or volatile compounds produced by its host plant, and to ensure that the material used as a repellent works by inhibiting the release of these aromas from the host plant. Based on the observations presented in Table 4.8, it was found that the average number of *D. citri* that moved toward kaolin-treated leaves was significantly different from the number of insects that moved toward untreated leaves (control) as well as those that did not move. The number of *D. citri* that selected the treated leaves was consistently the lowest at each observation time.

These results indicate that the K5H treatment, namely the application of 5% kaolin applied every five days, was able to reduce the attractiveness of citrus leaves to *D. citri.* The low number of insects moving toward the treated leaves suggests that the kaolin layer interfered with the olfactory cues (aromas) used by *D. citri* to recognize its host plant, possibly by blocking or covering the release of volatile compounds from the leaf surface. This explains the role of kaolin as a repellent through its particle layer, which is capable of suppressing the release of volatile compounds and forming a physical barrier that limits the detection of plant aromas by insects.

These findings are consistent with the statement of Poerwanto (2023), which notes that kaolin compounds coat the plant surface, thereby reducing the concentration of volatile compounds released into the air and making it difficult for *Diaphorina citri* to recognize its host. The kaolin layer also alters the spectrum of light reflected by the leaves, causing *D. citri* to fail to recognize its host plant. In addition, the thickness and continuity of the kaolin particle layer are critical factors in determining the effectiveness of insect protection. A thick and evenly distributed kaolin layer provides better protection than a layer that is uneven or easily washed off by rainfall.

3. Effect of Treatment on Shoot Growth

The observations of citrus shoot growth, including internode length, number of leaves, and leaf length, showed a consistent pattern across all three parameters. Overall, plants in the control treatment exhibited better growth than those treated with 5% kaolin. Shoot growth in control plants progressed more rapidly and consistently, whereas plants receiving the kaolin treatment showed relatively slower growth and lower average values at all observation times.

These differences were clearly observed across all measured parameters. Shoots in the control treatment had longer internodes, a greater number of leaves, and larger leaf size compared to plants treated with kaolin. This condition indicates that kaolin treatment suppressed the vegetative growth of citrus plants, suggesting that the presence of a kaolin layer on the leaf surface induced changes in plant physiological processes.

The growth-inhibiting effect is presumed to occur because the kaolin layer forms a particle film that covers part of the leaf surface, thereby affecting light absorption, gas exchange, and transpiration. This layer indeed functions as a physical barrier that can reduce heat stress and pest attacks; however, over a certain period it may decrease the efficiency of plant photosynthesis. This is in line with the study by Ramírez-Godoy *et al.* (2018), which stated that the use of kaolin reduced the photosynthetic rate of citrus trees by 25% compared to the control and other treatments. According to Khalilzadeh & Pierre *et al.* (2025), kaolin application can alter the microclimatic conditions around the leaf surface by increasing light reflectance. As a result, part of the radiant energy required for the photosynthesis process is reduced, leading to a decrease in the vegetative growth rate of the plant

Based on the observations from the non-choice and choice tests, the 5% kaolin application interval showed different levels of effectiveness in suppressing the biological responses of *Diaphorina citri*. These differences were clearly observed in the parameters of host-finding behavior, oviposition activity, number of eggs, number of nymphs, and the repellent index.

The application of kaolin at a five-day interval (K5H) was the most effective treatment compared to the other intervals. This treatment consistently reduced the number of *D. citri* settling on leaves and shoots, and at several observation times the number of individuals found reached zero. In addition, the repellent index value in the K5H treatment was the lowest, indicating the strongest repellent effect. This suggests that spraying at a five-day interval is able to optimally maintain the kaolin layer on the plant surface, thereby continuously disrupting the insects' visual perception and host-finding behavior as well as suppressing oviposition activity.

The application of kaolin at a ten-day interval (K10H) still showed effectiveness in suppressing the *D. citri* population; however, the results were not as good as those of the K5H treatment. In this treatment, the numbers of *D. citri* on leaves and shoots, as well as the number of eggs, tended to be higher than in K5H, although they remained lower than in the control. This is presumably because the effectiveness of the kaolin layer began to decrease before the next application was carried out, so plant protection was not maintained continuously.

The application of kaolin at a 15-day interval (K15H) showed the lowest effectiveness among the kaolin treatments, although it was still better than the untreated plants. At this interval, the number of *D. citri* settling, the number of eggs, and the repellent index tended to be higher than in K5H and K10H. An excessively long application interval causes the kaolin layer to be easily degraded by environmental factors such as dust, evaporation, or physical contact, thereby reducing the ability of kaolin to disrupt insect behavior.

In general, the shorter the kaolin application interval, the higher its effectiveness in suppressing the biological responses of *D. citri.* However, kaolin application at a five-day interval was also shown to have an impact on citrus shoot growth, as indicated by reductions in shoot length, number of leaves, and leaf length compared to the control. Therefore, although the five-day interval is the most effective for controlling *D. citri,* its field application needs to consider the balance between pest control effectiveness and plant growth.

CHAPTER V

CONCLUSION AND SUGGESTION

A. CONCLUSION

Based on the results and discussion, it can be concluded that:

1. Kaolin application intervals affected the host-finding behavior of *Diaphorina citri*. Shorter application intervals enhanced the repellent effect, thereby making it more difficult for *D. citri* to locate its host plants.
2. Kaolin application intervals influenced the oviposition behavior of *Diaphorina citri*. Kaolin application at various intervals reduced the number of eggs and nymphs on treated plants.
3. The most effective kaolin application interval for controlling *Diaphorina citri* was the K5H treatment, which involved kaolin application every 5 days. The K5H treatment showed the highest effectiveness in suppressing the number of *D. citri* on leaves and shoots and resulted in the highest repellency index value.

B. SUGGESTION

1. The application of 5% kaolin with a spraying interval of every five days is recommended for controlling *Diaphorina citri* on citrus plants, as it has been proven to be the most effective in suppressing host-finding behavior, oviposition activity, and the presence of adults and eggs compared to other application intervals.

2. The use of kaolin as part of Integrated Pest Management (IPM) is recommended to reduce dependence on synthetic chemical insecticides, thereby supporting more environmentally friendly and sustainable citrus cultivation systems.
3. Considering that kaolin application shows an effect on citrus shoot growth, further research is needed on the combination of dosage and application intervals that remain effective in suppressing *D. citri* while minimizing negative impacts on the vegetative growth of the plant.
4. Future studies are recommended to be conducted under field conditions (orchard scale) by considering environmental factors such as rainfall, light intensity, and kaolin adhesion, in order to obtain more applicable application recommendations for citrus farmers.
5. Further studies are needed to evaluate the effects of kaolin application on the natural enemies of *Diaphorina citri,* so that its use within an IPM system can be optimized without disrupting the balance of the agroecological ecosystem.

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EPPENDIX

Lampiran I Spesifikasi Kaolin

SAFETY DATA SHEET

SURROUND® WP CROP PROTECTANT

Date of Issue: 23 December 2022

1. IDENTIFICATION

Product Identifier:	**Surround® WP Crop Protectant**
Other Means of Identification:	Surround WP
Recommended Use of the Chemical and Restrictions on Use:	**Crop Protectant**
Details of Manufacturer or Importer:	AgNova Technologies Pty Ltd Unit 4, 482 Kingsford Smith Drive Hamilton Qld 4007 Australia (03) 9899 8100 agnova.com.au
Emergency Phone Number:	1800 033 111 (24 hrs) IXOM ERS 13 11 26 Poisons Information Centre

2. HAZARD(S) IDENTIFICATION

GHS CLASSIFICATIONS

HAZARD CLASSIFICATION

Health Hazards	Category	Physical Hazards	Category
None	-	None	-
		Environmental Hazards	**Category**
		None	-

HAZARDS NOT REQUIRING CLASSIFICATION

None

PRECAUTIONARY STATEMENTS

None

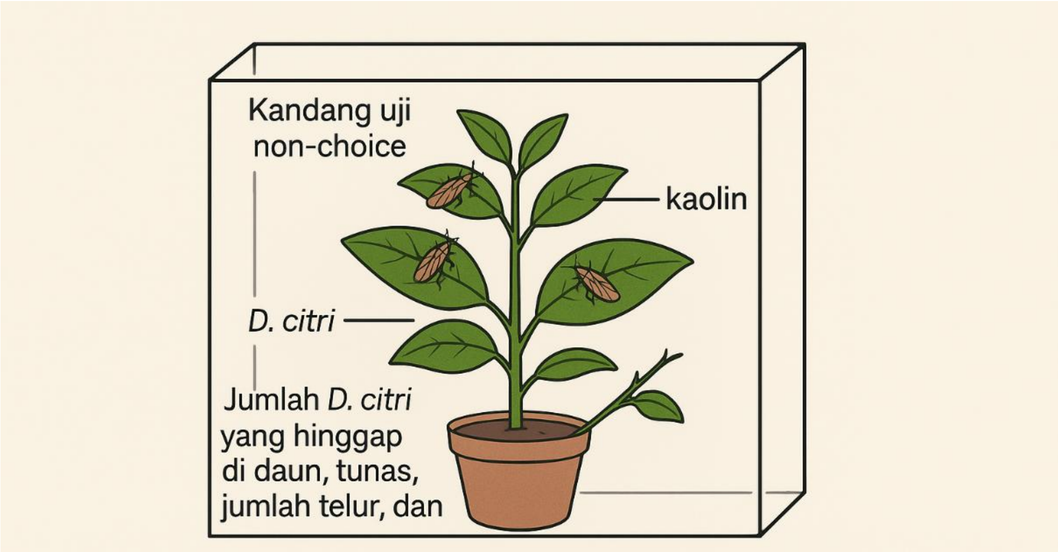
OTHER CLASSIFICATIONS

ADG Classification:	Not classified as Dangerous Goods for land transport under the Australian Code for Transport of Dangerous Goods by Road and Rail – refer Section 14.
SUSMP Classification:	Not scheduled (Standard for Uniform Scheduling of Medicines and Poisons)

Page 1 of 8

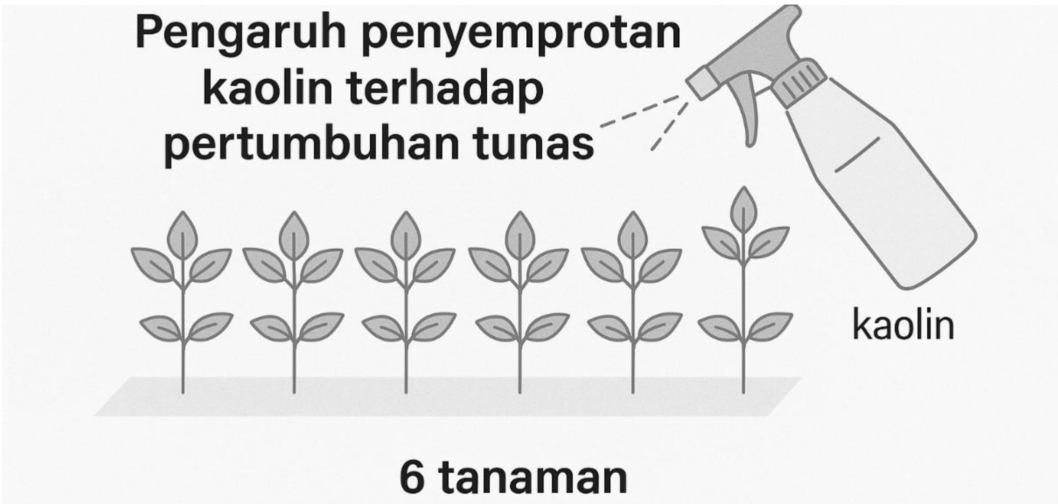
Lampiran II Tata Letak Penelitian

A. Tata Letak Non-Choice Test



B. Tata Letak Choice Test

C. Tata Letak Pengaruh Pertumbuhan Tunas



Lampiran III Hasil dari Metode Analisis

NON-CHOICE

Jumlah *Citri* pada Daun D16

ANOVA TABLE

Response Variable: JCPD..16.

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	2157.2000	719.0667	119.84	0.0000
Error	16	96.0000	6.0000		
Total	19	2253.2000			

Summary Statistics

CV(%)	JCPD..16. Mean
20.76	11.80

Standard Errors

Effects	StdErr
Perlakuan	1.55

Response Variable: JCPD..16.

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	6.0000

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	3.2841	3.4439	3.5437

Summary of the Result:

Perlakuan	means	N	group
K10H	4.20	5	c
K15H	11.60	5	b
K5H	2.60	5	c
Kontrol	28.80	5	a

Jumlah *Citri* pada Daun D18

```
ANOVA TABLE
Response Variable: JCPD..18.
------------------------------------------------------------
Source        DF  Sum of Square  Mean Square  F Value Pr(> F)
------------------------------------------------------------
Perlakuan      3      2128.5500     709.5167    46.45  0.0000
Error         16       244.4000      15.2750
Total         19      2372.9500
------------------------------------------------------------

Summary Statistics
------------------------
  CV(%)   JCPD..18. Mean
------------------------
  46.25             8.45
------------------------

Standard Errors
--------------------
Effects       StdErr
--------------------
Perlakuan       2.47
--------------------

Response Variable:  JCPD..18.

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha                              0.05
Error Degrees of Freedom             16
Error Mean Square               15.2750

-----------------------------------------
Number of Means         2       3       4
-----------------------------------------
Tabular Value      2.9980  3.1438  3.2349
Test Statistics    5.2401  5.4949  5.6542
-----------------------------------------

Summary of the Result:
---------------------------------
Perlakuan     means     N group
---------------------------------
K10H           3.40     5  b
K15H           3.60     5  b
K5H            0.60     5  b
Kontrol       26.20     5 a
---------------------------------
```

Jumlah *Citri* pada Daun D20

```
ANOVA TABLE
Response Variable: JCPD..20.
------------------------------------------------------------
```

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	2378.9500	792.9833	56.14	0.0000
Error	16	226.0000	14.1250		
Total	19	2604.9500			

Summary Statistics

CV(%)	JCPD..20. Mean
47.27	7.95

Standard Errors

Effects	StdErr
Perlakuan	2.38

Response Variable: JCPD..20.

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	14.1250

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	5.0390	5.2840	5.4372

Summary of the Result:

Perlakuan	means	N	group
K10H	2.60	5	b
K15H	1.80	5	b
K5H	0.60	5	b
Kontrol	26.80	5	a

Jumlah *Citri* pada Daun D22

ANOVA TABLE

Response Variable: JCPD..22.

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	2341.0000	780.3333	78.62	0.0000
Error	16	158.8000	9.9250		
Total	19	2499.8000			

Summary Statistics

CV(%)	JCPD..22. Mean
45.66	6.90

Standard Errors

Effects	StdErr
Perlakuan	1.99

Response Variable: JCPD..22.

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	9.9250

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	4.2239	4.4293	4.5577

Summary of the Result:

Perlakuan	means	N	group
K10H	0.20	5	b
K15H	1.80	5	b
K5H	0.00	5	b
Kontrol	25.60	5	a

Jumlah *Citri* pada Daun D24

ANOVA TABLE
Response Variable: JCPD..24.

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	2978.8000	992.9333	74.80	0.0000
Error	16	212.4000	13.2750		
Total	19	3191.2000			

Summary Statistics

CV(%)	JCPD..24. Mean
32.53	11.20

Standard Errors

Effects	StdErr
Perlakuan	2.30

Response Variable: JCPD..24.

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	13.2750

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	4.8850	5.1226	5.2711

Summary of the Result:

Perlakuan	means	N	group
K10H	3.60	5	b
K15H	6.40	5	b
K5H	2.60	5	b
Kontrol	32.20	5	a

Jumlah *Citri* pada Daun D26

ANOVA TABLE

Response Variable: JCPD..26.

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	2606.0000	868.6667	146.61	0.0000
Error	16	94.8000	5.9250		
Total	19	2700.8000			

Summary Statistics

CV(%)	JCPD..26. Mean
23.41	10.40

Standard Errors

Effects	StdErr
Perlakuan	1.54

Response Variable: JCPD..26.

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	5.9250

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	3.2636	3.4223	3.5215

Summary of the Result:

Perlakuan	means	N	group
K10H	4.20	5	bc
K15H	5.80	5	b
K5H	1.60	5	c
Kontrol	30.00	5	a

Jumlah *Citri* pada Daun D28

ANOVA TABLE

Response Variable: JCPD..28.

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	2945.3500	981.7833	265.35	0.0000
Error	16	59.2000	3.7000		
Total	19	3004.5500			

Summary Statistics

CV(%)	JCPD..28. Mean
18.95	10.15

Standard Errors

Effects	StdErr

Perlakuan	1.22

Response Variable: JCPD..28.

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	3.7000

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	2.5790	2.7044	2.7828

Summary of the Result:

Perlakuan	means	N	group
K10H	3.40	5	c
K15H	6.40	5	b
K5H	0.00	5	d
Kontrol	30.80	5	a

Jumlah *Citri* pada Daun D30

ANOVA TABLE

Response Variable: JCPD..30.

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	3762.9500	1254.3167	187.91	0.0000
Error	16	106.8000	6.6750		
Total	19	3869.7500			

Summary Statistics

CV(%)	JCPD..30. Mean
21.99	11.75

Standard Errors

Effects	StdErr
Perlakuan	1.63

Response Variable: JCPD..30.

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	6.6750

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	3.4640	3.6324	3.7377

Summary of the Result:

Perlakuan	means	N	group
K10H	3.60	5	c
K15H	7.20	5	b
K5H	1.00	5	c
Kontrol	35.20	5	a

Jumlah Citri pada Tunas D14

ANOVA TABLE

Response Variable: JPT.14

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	0.5571	0.1857	1.89	0.1726
Error	16	1.5750	0.0984		
Total	19	2.1321			

Summary Statistics

CV(%)	JPT.14 Mean
35.19	0.8915

Standard Errors

Effects	StdErr
Perlakuan	0.1984

Table of Means

Perlakuan	JPT.14 Means

K10H	0.71
K15H	0.81
K5H	0.88
Kontrol	1.16

Jumlah Citri pada Tunas D16

ANOVA TABLE

Response Variable: JPT.16

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	1.0619	0.3540	1.23	0.3326
Error	16	4.6184	0.2886		
Total	19	5.6803			

Summary Statistics

CV(%)	JPT.16 Mean
45.98	1.17

Standard Errors

Effects	StdErr
Perlakuan	0.3398

Table of Means

Perlakuan	JPT.16 Means
K10H	0.99
K15H	1.29
K5H	0.91
Kontrol	1.48

Jumlah Citri pada Tunas D18

ANOVA TABLE

Response Variable: JPT.18

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	2.9635	0.9878	3.39	0.0440
Error	16	4.6645	0.2915		
Total	19	7.6280			

Summary Statistics

CV(%)	JPT.18 Mean
46.11	1.17

Standard Errors

Effects	StdErr
Perlakuan	0.3415

Response Variable: JPT.18

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	0.2915

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	0.7239	0.7591	0.7811

Summary of the Result:

Perlakuan	means	N	group
K10H	1.23	5	ab
K15H	0.99	5	b
K5H	0.71	5	b
Kontrol	1.76	5	a

Jumlah Citri pada Tunas D20

ANOVA TABLE

Response Variable: JPT.20

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	0.8772	0.2924	3.65	0.0352
Error	16	1.2804	0.0800		
Total	19	2.1576			

Summary Statistics

CV(%)	JPT.20 Mean
32.80	0.8625

Standard Errors

Effects	StdErr

Perlakuan	0.1789

Response Variable: JPT.20

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	0.0800

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	0.3793	0.3977	0.4092

Summary of the Result:

Perlakuan	means	N	group
K10H	0.81	5	b
K15H	0.71	5	b
K5H	0.71	5	b
Kontrol	1.22	5	a

Jumlah Citri pada Tunas D22

ANOVA TABLE

Response Variable: JPT.22

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	1.9571	0.6524	3.76	0.0323
Error	16	2.7775	0.1736		
Total	19	4.7346			

Summary Statistics

CV(%)	JPT.22 Mean
43.54	0.9570

Standard Errors

Effects	StdErr
Perlakuan	0.2635

Response Variable: JPT.22

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	0.1736

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	0.5586	0.5858	0.6028

Summary of the Result:

Perlakuan	means	N	group
K10H	0.81	5	b
K15H	0.81	5	b
K5H	0.71	5	b
Kontrol	1.49	5	a

Jumlah Citri pada Tunas D24

ANOVA TABLE

Response Variable: JPT.24

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	0.6015	0.2005	0.81	0.5046
Error	16	3.9403	0.2463		
Total	19	4.5418			

Summary Statistics

CV(%)	JPT.24 Mean
43.19	1.15

Standard Errors

Effects	StdErr
Perlakuan	0.3139

Table of Means

Perlakuan	JPT.24 Means
K10H	1.02
K15H	0.99

K5H	1.16
Kontrol	1.43

Jumlah Citri pada Tunas D26

ANOVA TABLE

Response Variable: JPT.26

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	1.1793	0.3931	2.11	0.1390
Error	16	2.9789	0.1862		
Total	19	4.1582			

Summary Statistics

CV(%)	JPT.26 Mean
42.26	1.02

Standard Errors

Effects	StdErr
Perlakuan	0.2729

Table of Means

Perlakuan	JPT.26 Means
K10H	0.71
K15H	1.09
K5H	0.91
Kontrol	1.37

Jumlah Citri pada Tunas D28

ANOVA TABLE

Response Variable: JPT.28

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	0.6227	0.2076	1.49	0.2558
Error	16	2.2333	0.1396		
Total	19	2.8560			

Summary Statistics

CV(%)	JPT.28 Mean
44.32	0.8430

Standard Errors

Effects	StdErr
Perlakuan	0.2363

Table of Means

Perlakuan	JPT.28 Means
K10H	0.71
K15H	0.71
K5H	0.81
Kontrol	1.14

Jumlah Citri pada Tunas D30

ANOVA TABLE
Response Variable: JPT.30

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	1.1161	0.3720	1.48	0.2566
Error	16	4.0109	0.2507		
Total	19	5.1270			

Summary Statistics

CV(%)	JPT.30 Mean
51.48	0.9725

Standard Errors

Effects	StdErr
Perlakuan	0.3167

Table of Means

Perlakuan	JPT.30 Means
K10H	0.88
K15H	0.94
K5H	0.71
Kontrol	1.35

Jumlah Telur pada Tunas D14

ANOVA TABLE

Response Variable: TPT.14

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	32.2373	10.7458	14.07	0.0001
Error	16	12.2197	0.7637		
Total	19	44.4570			

Summary Statistics

CV(%)	TPT.14 Mean
60.56	1.44

Standard Errors

Effects	StdErr
Perlakuan	0.5527

Response Variable: TPT.14

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	0.7637

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	1.1717	1.2287	1.2643

Summary of the Result:

Perlakuan	means	N	group
K10H	0.71	5	b
K15H	0.71	5	b
K5H	0.71	5	b
Kontrol	3.64	5	a

Jumlah Telur pada Tunas D16

ANOVA TABLE

Response Variable: TPT.16

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)

Perlakuan	3	21.8527	7.2842	13.40	0.0001
Error	16	8.6957	0.5435		
Total	19	30.5485			

Summary Statistics

CV(%)	TPT.16 Mean
56.13	1.31

Standard Errors

Effects	StdErr
Perlakuan	0.4663

Response Variable: TPT.16

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	0.5435

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	0.9884	1.0365	1.0665

Summary of the Result:

Perlakuan	means	N	group
K10H	0.71	5	b
K15H	0.71	5	b
K5H	0.71	5	b
Kontrol	3.12	5	a

Jumlah Telur pada Tunas D18

ANOVA TABLE

Response Variable: TPT.18

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	7.7113	2.5704	4.82	0.0142
Error	16	8.5401	0.5338		
Total	19	16.2515			

Summary Statistics

CV(%)	TPT.18 Mean
68.38	1.07

Standard Errors

Effects	StdErr
Perlakuan	0.4621

Response Variable: TPT.18

Pairwise Mean Comparison of Perlakuan

Duncan's Multiple Range Test (DMRT)

Alpha	0.05
Error Degrees of Freedom	16
Error Mean Square	0.5338

Number of Means	2	3	4
Tabular Value	2.9980	3.1438	3.2349
Test Statistics	0.9795	1.0272	1.0569

Summary of the Result:

Perlakuan	means	N	group
K10H	0.71	5	b
K15H	0.71	5	b
K5H	0.71	5	b
Kontrol	2.14	5	a

Jumlah Telur pada Tunas D20

ANOVA TABLE

Response Variable: TPT.20

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	2.0424	0.6808	2.17	0.1316
Error	16	5.0233	0.3140		
Total	19	7.0657			

Summary Statistics

CV(%)	TPT.20 Mean
62.64	0.8945

Standard Errors

Effects	StdErr
Perlakuan	0.3544

Table of Means

Perlakuan	TPT.20 Means
K10H	0.71
K15H	0.71
K5H	0.71
Kontrol	1.45

Jumlah Telur pada Tunas D22

-

Jumlah Telur pada Tunas D24

-

Jumlah Telur pada Tunas D26

-

Jumlah Telur pada Tunas D28

-

Jumlah Telur pada Tunas D30

-

Jumlah Citri pada Nimfa D14

ANOVA TABLE

Response Variable: NPT.14

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	4.0639	1.3546	1.97	0.1586
Error	16	10.9822	0.6864		
Total	19	15.0461			

Summary Statistics

CV(%)	NPT.14 Mean
80.83	1.02

Standard Errors

Effects	StdErr
Perlakuan	0.5240

Table of Means

Perlakuan	NPT.14 Means
K10H	0.71
K15H	0.88
K5H	0.71
Kontrol	1.80

Jumlah Citri pada Nimfa D16

ANOVA TABLE

Response Variable: NPT.16

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	3.0510	1.0170	1.91	0.1680
Error	16	8.5001	0.5313		
Total	19	11.5511			

Summary Statistics

CV(%)	NPT.16 Mean
77.91	0.9355

Standard Errors

Effects	StdErr
Perlakuan	0.4610

Table of Means

Perlakuan	NPT.16 Means
K10H	0.71
K15H	0.71
K5H	0.71
Kontrol	1.61

Jumlah Citri pada Nimfa D18

ANOVA TABLE

Response Variable: NPT.16

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	3.0510	1.0170	1.91	0.1680
Error	16	8.5001	0.5313		
Total	19	11.5511			

Summary Statistics

CV(%)	NPT.16 Mean
77.91	0.9355

Standard Errors

Effects	StdErr
Perlakuan	0.4610

Table of Means

Perlakuan	NPT.16 Means
K10H	0.71
K15H	0.71
K5H	0.71
Kontrol	1.61

Jumlah Citri pada Nimfa D20

ANOVA TABLE

Response Variable: NPT.20

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	6.4550	2.1517	2.85	0.0700
Error	16	12.0621	0.7539		
Total	19	18.5171			

Summary Statistics

CV(%)	NPT.20 Mean
83.65	1.04

Standard Errors

Effects	StdErr
Perlakuan	0.5491

Table of Means

Perlakuan	NPT.20 Means
K10H	0.71
K15H	0.71
K5H	0.71
Kontrol	2.02

Jumlah Citri pada Nimfa D22

ANOVA TABLE

Response Variable: NPT.22

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	3.8557	1.2852	2.37	0.1089
Error	16	8.6775	0.5423		
Total	19	12.5333			

Summary Statistics

CV(%)	NPT.22 Mean
76.43	0.9635

Standard Errors

Effects	StdErr
Perlakuan	0.4658

Table of Means

Perlakuan	NPT.22 Means
K10H	0.71
K15H	0.71
K5H	0.71
Kontrol	1.72

Jumlah Citri pada Nimfa D24

ANOVA TABLE

Response Variable: NPT.24

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	4.0560	1.3520	2.63	0.0855
Error	16	8.2178	0.5136		
Total	19	12.2738			

Summary Statistics

CV(%)	NPT.24 Mean
73.88	0.9700

Standard Errors

Effects	StdErr
Perlakuan	0.4533

Table of Means

Perlakuan	NPT.24 Means
K10H	0.71
K15H	0.71
K5H	0.71
Kontrol	1.75

Jumlah Citri pada Nimfa D26

ANOVA TABLE

Response Variable: NPT.26

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	2.8253	0.9418	1.67	0.2136
Error	16	9.0307	0.5644		
Total	19	11.8560			

Summary Statistics

CV(%)	NPT.26 Mean
81.04	0.9270

Standard Errors

Effects	StdErr
Perlakuan	0.4751

Table of Means

Perlakuan	NPT.26 Means
K10H	0.71
K15H	0.71
K5H	0.71
Kontrol	1.58

Jumlah Citri pada Nimfa D28

ANOVA TABLE

Response Variable: NPT.28

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)

Perlakuan	3	0.6181	0.2060	1.00	0.4182
Error	16	3.2967	0.2060		
Total	19	3.9149			

Summary Statistics

CV(%)	NPT.28 Mean
55.94	0.8115

Standard Errors

Effects	StdErr
Perlakuan	0.2871

Table of Means

Perlakuan	NPT.28 Means
K10H	0.71
K15H	0.71
K5H	0.71
Kontrol	1.12

Jumlah Citri pada Nimfa D30

ANOVA TABLE

Response Variable: NPT.30

Source	DF	Sum of Square	Mean Square	F Value	Pr(> F)
Perlakuan	3	0.0390	0.0130	1.00	0.4182
Error	16	0.2081	0.0130		
Total	19	0.2471			

Summary Statistics

CV(%)	NPT.30 Mean
15.51	0.7355

Standard Errors

Effects	StdErr
Perlakuan	0.0721

Table of Means

Perlakuan	NPT.30 Means

```
-------------------------
K10H              0.7100
K15H              0.7100
K5H               0.7100
Kontrol           0.8120
-------------------------
```

PERHITUNGAN INDEKS REPELENSI

Perlakuan	Ulangan	JCPD	JCPT	Hidup	Jumlah	Rata - Rata	Mati	Jumlah	Rata - Rata	IR
Kontrol	1	36	0	36	185	37	29	140	28	1,13846
Kontrol	2	35	0	35			30			
Kontrol	3	36	1	37			28			
Kontrol	4	29	6	35			30			
Kontrol	5	40	2	42			23			
K5H	1	1	0	1	5	1	64	320	64	0,03077
K5H	2	1	0	1			64			
K5H	3	2	0	2			63			
K5H	4	0	0	0			65			
K5H	5	1	0	1			64			
K10H	1	5	0	5	20	4	60	305	61	0,12308
K10H	2	4	0	4			61			
K10H	3	5	0	5			60			
K10H	4	3	0	3			62			
K10H	5	1	2	3			62			
K15H	1	8	0	8	39	7,8	57	286	57,2	0,24
K15H	2	11	0	11			54			
K15H	3	8	0	8			57			
K15H	4	4	3	7			58			
K15H	5	5	0	5			60			

Indeks Repellency (IR) dihitung dengan rumus dari Mazzonetto (2003):

$$\mathbf{IR} = \frac{2G}{G + P}$$

G: jumlah serangga yang ada di area diberi perlakuan P: jumlah serangga yang ada di area tidak diberi perlakuan. Nilai IR diklasifikasikan sebagai: IR < 1 penolak, IR = 1 netral, IR > 1 atraktan.

CHOICE TEST

Uji T Choice 20 menit

	Kontrol	*Kaolin*
Mean	0,333333333	1
Variance	0,266666667	1,6
Observations	6	6
Hypothesized Mean Difference	0	
Df	7	
t Stat	-1,195228609	
P(T<=t) one-tail	0,135457527	
t Critical one-tail	1,894578605	
P(T<=t) two-tail	0,270915053	
t Critical two-tail	2,364624252	

Uji T Choice 40 menit

	Kontrol	*Kaolin*
Mean	3,166666667	1
Variance	2,566666667	1,6
Observations	6	6
Hypothesized Mean Difference	0	
Df	9	
t Stat	2,6	
P(T<=t) one-tail	0,014369114	
t Critical one-tail	1,833112933	
P(T<=t) two-tail	0,028738227	
t Critical two-tail	2,262157163	

Uji T Choice 60 menit

	Kontrol	*Kaolin*
Mean	4,833333333	0,83333333
Variance	4,966666667	0,96666667
Observations	6	6
Hypothesized Mean Difference	0	
Df	7	
t Stat	4,022409139	

P(T<=t) one-tail	0,002522077
t Critical one-tail	1,894578605
P(T<=t) two-tail	0,005044153
t Critical two-tail	2,364624252

PENGARUH PERTUMBUHAN TUNAS

Panjang Tunas

Uji T Panjang Tunas Day 0

	Kontrol	*Kaolin*
Mean	4,8	3,283333
Variance	0,14	6,581667
Observations	6	6
Hypothesized Mean Difference	0	
df	5	
t Stat	1,432938	
P(T<=t) one-tail	0,105658	
t Critical one-tail	2,015048	
P(T<=t) two-tail	0,211315	
t Critical two-tail	2,570582	

Uji T Panjang Tunas Day 5

	Kontrol	*Kaolin*
Mean	10,85	5,816667
Variance	1,323	21,14167
Observations	6	6
Hypothesized Mean Difference	0	
df	6	
t Stat	2,601245	
P(T<=t) one-tail	0,020297	

t Critical one-tail	1,94318
P(T<=t) two-tail	0,040594
t Critical two-tail	2,446912

Uji T Panjang Tunas Day 15

	Kontrol	*Kaolin*
Mean	17,01667	8,533333
Variance	3,461667	44,06267
Observations	6	6
Hypothesized Mean Difference	0	
df	6	
t Stat	3,014284	
P(T<=t) one-tail	0,011785	
t Critical one-tail	1,94318	
P(T<=t) two-tail	0,02357	
t Critical two-tail	2,446912	

Uji T Panjang Tunas Day 15

	Kontrol	*Kaolin*
Mean	22,18333	10,78333
Variance	4,357667	70,08567
Observations	6	6
Hypothesized Mean Difference	0	
df	6	
t Stat	3,23644	
P(T<=t) one-tail	0,008883	
t Critical one-tail	1,94318	
P(T<=t) two-tail	0,017766	
t Critical two-tail	2,446912	

Uji T Panjang Tunas Day 20

	Kontrol	*Kaolin*
Mean	27,33333	13,33333
Variance	4,438667	106,9467
Observations	6	6
Hypothesized Mean Difference	0	
df	5	
t Stat	3,249299	
P(T<=t) one-tail	0,011357	
t Critical one-tail	2,015048	
P(T<=t) two-tail	0,022714	
t Critical two-tail	2,570582	

Uji T Panjang Tunas Day 25

	Kontrol	*Kaolin*
Mean	28	12,2
Variance	190,272	178,62
Observations	6	6
Hypothesized Mean Difference	0	
df	10	
t Stat	2,015037	
P(T<=t) one-tail	0,035785	
t Critical one-tail	1,812461	
P(T<=t) two-tail	0,071571	
t Critical two-tail	2,228139	

Uji T Panjang Tunas Day 30

	Kontrol	*Kaolin*
Mean	32,43333	9,466667

Variance	255,3547	215,0867
Observations	6	6
Hypothesized Mean Difference	0	
df	10	
t Stat	2,593707	
P(T<=t) one-tail	0,01339	
t Critical one-tail	1,812461	
P(T<=t) two-tail	0,026779	
t Critical two-tail	2,228139	

Jumlah Daun

Uji T Jumlah Daun Day 5

	Kontrol	*Kaolin*
Mean	4,5	2,5
Variance	0,7	3,9
Observations	6	6
Hypothesized Mean Difference	0	
df	7	
t Stat	2,284161	
P(T<=t) one-tail	0,028145	
t Critical one-tail	1,894579	
P(T<=t) two-tail	0,05629	
t Critical two-tail	2,364624	

Uji T Jumlah Daun Day 10

	Kontrol	*Kaolin*
Mean	5,166667	2,6666667
Variance	0,566667	4,2666667
Observations	6	6
Hypothesized Mean Difference	0	
df	6	
t Stat	2,78543	
P(T<=t) one-tail	0,015884	
t Critical one-tail	1,94318	
P(T<=t) two-tail	0,031768	

t Critical two-tail	2,446912

Uji T Jumlah Daun Day 10

	Kontrol	*Kaolin*
Mean	6	2,8333333
Variance	0,8	4,9666667
Observations	6	6
Hypothesized Mean Difference	0	
df	7	
t Stat	3,230097	
P(T<=t) one-tail	0,007225	
t Critical one-tail	1,894579	
P(T<=t) two-tail	0,01445	
t Critical two-tail	2,364624	

Uji T Jumlah Daun Day 20

	Kontrol	*Kaolin*
Mean	7,166667	3,333333
Variance	0,566667	7,066667
Observations	6	6
Hypothesized Mean Difference	0	
df	6	
t Stat	3,398561	
P(T<=t) one-tail	0,007261	
t Critical one-tail	1,94318	
P(T<=t) two-tail	0,014522	
t Critical two-tail	2,446912	

Uji T Jumlah Daun Day 25

	Kontrol	*Kaolin*
Mean	6	2,666667
Variance	10,8	9,066667
Observations	6	6
Hypothesized Mean Difference	0	
df	10	
t Stat	1,831858	
P(T<=t) one-tail	0,04844	
t Critical one-tail	1,812461	

P(T<=t) two-tail	0,096881
t Critical two-tail	2,228139

Uji T Jumlah Daun Day 30

	Kontrol	*Kaolin*
Mean	6,333333	2
Variance	9,866667	9,6
Observations	6	6
Hypothesized Mean Difference	0	
df	10	
t Stat	2,405758	
P(T<=t) one-tail	0,018475	
t Critical one-tail	1,812461	
P(T<=t) two-tail	0,03695	
t Critical two-tail	2,228139	

Panjang Daun

Uji T Panjang Daun Day 5

	Kontrol	*Kaolin*
Mean	22,88333	11,81667
Variance	5,613667	87,56567
Observations	6	6
Hypothesized Mean Difference	0	
df	6	
t Stat	2,80823	
P(T<=t) one-tail	0,015414	
t Critical one-tail	1,94318	
P(T<=t) two-tail	0,030828	
t Critical two-tail	2,446912	

Uji T Panjang Daun Day 10

	Kontrol	*Kaolin*
Mean	35,63333	16,26667
Variance	26,80667	159,6427
Observations	6	6
Hypothesized Mean Difference	0	

df	7	
t Stat	3,474162	
P(T<=t) one-tail	0,005174	
t Critical one-tail	1,894579	
P(T<=t) two-tail	0,010348	
t Critical two-tail	2,364624	

Uji T Panjang Daun Day 15

	Kontrol	*Kaolin*
Mean	46,3	21,16667
Variance	31,256	269,9867
Observations	6	6
Hypothesized Mean Difference	0	
df	6	
t Stat	3,547051	
P(T<=t) one-tail	0,006058	
t Critical one-tail	1,94318	
P(T<=t) two-tail	0,012115	
t Critical two-tail	2,446912	

Uji T Panjang Daun Day 20

	Kontrol	*Kaolin*
Mean	57,76667	25,1
Variance	51,26267	392,464
Observations	6	6
Hypothesized Mean Difference	0	
df	6	
t Stat	3,798592	
P(T<=t) one-tail	0,004491	
t Critical one-tail	1,94318	
P(T<=t) two-tail	0,008983	
t Critical two-tail	2,446912	

Uji T Panjang Daun Day 25

	Kontrol	*Kaolin*
Mean	58,48333	22,31667
Variance	835,0377	602,9577

Observations	6	6
Hypothesized Mean Difference	0	
df	10	
t Stat	2,336175	
P(T<=t) one-tail	0,020805	
t Critical one-tail	1,812461	
P(T<=t) two-tail	0,04161	
t Critical two-tail	2,228139	

Uji T Panjang Daun Day 30

	Kontrol	*Kaolin*
Mean	71,43333	18,63333
Variance	1267,311	835,0467
Observations	6	6
Hypothesized Mean Difference	0	
Df	10	
t Stat	2,820696	
P(T<=t) one-tail	0,00907	
t Critical one-tail	1,812461	
P(T<=t) two-tail	0,018139	
t Critical two-tail	2,228139	

Lampiran IV Gambar Kegiatan Penelitian

NON-CHOICE TEST

Perlakuan 1, Penyemprotan Kaolin Setiap Lima Hari Sekali

Kontrol

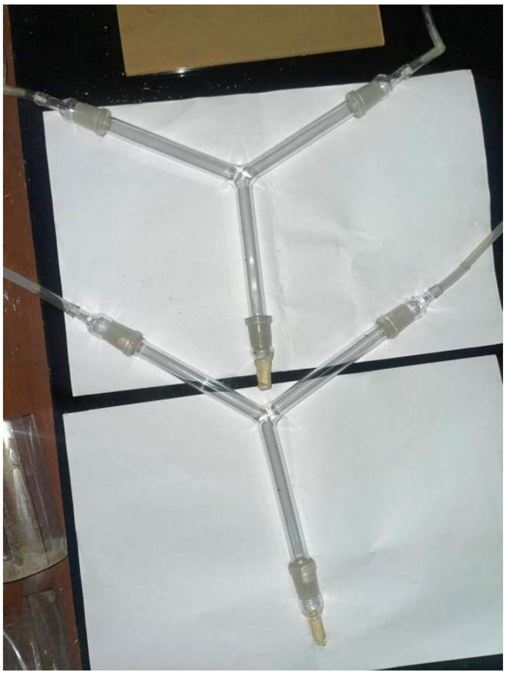
Perlakuan 2, Penyemprotan Kaolin Setiap 10 Hari Sekali

Perlakuan 3, Penyemprotan Kaolin Setiap 15 Hari Sekali

CHOICE TEST

Diaphorina Citri di Ujung Tabung Y

Diaphorina Citri di Menuju Sumber Bau



Tabung Y

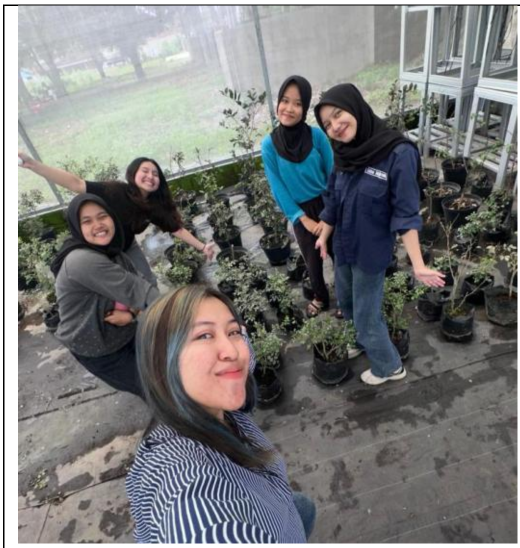
Rangkaian Y-Tube

PENGARUH PERTUMBUHAN TUNAS

 Penyemprotan Kaolin	 Penyemprotan Kaolin

 Kontrol	 Kontrol

KEGIATAN

 Pemeliharaan Tanaman	 Pembuatan Kaolin