Effects of neem plant extract (*Azadirachta indica* A. Juss) and bio-surfactant diethanolamide olein from palm oil to the mortality of cacao moth pest (*Conopomorpha cramerella*)

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Abstract. This study aims to determine the response of the addition of neem plant extract (*Azadirachta indica* A. Juss) and biosurfactant of diethanolamide olein palm to the mortality of cocoa moth pest (*Conopomorpha cramerella*). The research was carried out with experiments. The treatment consisted of 5 levels, namely (1) control (without treatment), (2) young leaf extract of neem plant consisted of 100 ml / 500 ml of water + 5% of biosurfactant diethanolamide palm olein, (3) old leaf extract of neem plant consisted of 100 ml / 500 ml of water + 5% of biosurfactant diethanolamide palm olein, (4) seed extract of neem plant consisted of 100 ml / 500 ml of water + 5% of biosurfactant diethanolamide olein palm, (5) young leaf extract of neem plant and seed extract of neem plant consisted of 100 ml / 500 ml of water + 5% of biosurfactant diethanolamide olein palm, (6) old leaf extract of neem plant and seed extract of neem plant consisted of 100 ml / 500 ml of water + 5% of biosurfactant diethanolamide olein palm. The results showed that the treatment of neem plant extracts mixture of young leaves and seeds + biosurfactant diethanolamide olein palm gave the best influence in controlling cocoa moth pests. Furthermore, it was followed by the treatment of neem plant extracts mixed with old leaves and seeds + biosurfactant diethanolamide olein palm.

Keywords: Neem plant, Bio-surfactant diethanolamide olein palm, cocoa moth pest.

1. Introduction

The cocoa plant (*Theobroma cacao* L.) is one of the potential foreign exchange producing plant, besides that it is an important plantation commodity in Indonesia because it has been developed in the field of agro-industry, such as processing chocolate products, cosmetic raw materials, pharmaceuticals and other industries [1].

According to the [2], the development of cocoa bean production in 2012 to 2015 decreased by around 19.87%, from 740.5 thousand tons to 593.3 thousand tons. One of the contributing factors is the condition of plants that are old, damaged, and unproductive and exposed to pest attacks with severe attacks. According to the [3], as many as 235,000 ha of cocoa plants are less productive due to being attacked by pests and diseases with moderate attacks. One of the reasons for the decline in national cocoa production and productivity is caused by the attack of *Conopomorpha cramerella* (Snellen) cocoa...
pod borer [4]. Cacao fruit borer (PBK) C. cramerella is the main pest in cocoa which causes a lot of losses for farmers, especially in Indonesia [5]. This PBK pest is very destructive because it causes the cocoa beans to not develop; the seeds stick together and are black.

Efforts to control cocoa pod borer, farmers still depend on the use of synthetic pesticides (chemical), assuming that synthetic pesticides are more effective in controlling plant pest organisms (OPT). However, the use of synthetic pesticides has been shown to cause various negative impacts such as resistance, pest resurgence, the emergence of secondary pests, pesticide residues that pollute agricultural products and the environment which endanger the lives of non-target organisms (natural enemies / biological control agents) [6]. The presence of pesticide residues in agricultural products including cocoa beans will cause poisoning in humans, pets and the occurrence of other hazards in everyday life.

Vegetable pesticides are sourced from plants that have secondary metabolic compounds that are repellents, antifeedant/feeding, developmental inhibitors and oviposition repelent/deterrent and as chemicals that kill insects quickly [7] Vegetable pesticides are non-persistent in nature, so they can control plant pest organisms. One of the plants that are as a vegetable pesticide (biopesticide) is a neem plant (Azadirachta indica A. Juss). This plant contains the active ingredient such as azadirachtin (C35H44O16), meliantriol, salanin, neem, nimbidine and other ingredients.

According to [8] on the use of vegetable pesticides, surfactants that have the potential to be applied in neem pesticides are diethanolamide surfactant (DEA) derived from palm olein methyl ester. DEA surfactants are included in the group of nonionic surfactants that are biodegradable and environmentally friendly and also function as good dispersers and reducing surface tension and interface tension which is quite effective, so that DEA surfactants have the potential to increase the effectiveness of vegetable pesticides (biopesticides).

The purpose of this research was to determine the response of extracts of several parts of Neem Plant (Azadirachta indica A. Juss) plus Palm Olein Dietanolamide Biosurfactant on the Resistance Level of Cocoa Fruit Borer (Conopomorpha cramerella).

2. Methodology

The research was conducted from July 2018 to September 2018 at the Basic Science and Plant Protection Laboratory of the Faculty of Agriculture, Sultan Ageng Tirtayasa University, Serang, Banten, Indonesia.

The materials and tools used in this research consisted of cocoa fruit which had been attacked by cocoa stem borer (PBK) taken from Cikuya Village, Sindang Sari Village, Pabuaran District, Serang Regency, Banten Province, young leaves, old leaves and neem seeds, palm olein diethanolamide biosurfactant, jars, analytical balance sheets, microscopes, Erlenmeyer, Petridis

The research was conducted by experiment. The treatment consisted of 6 levels, namely (P0) control (without treatment), (P1) young leaf extract of neem plant 100 ml / 500 ml of water + 5% of palm olein diethanolamide biosurfactant, (P2) old leaves extract of neem plant 100 ml / 500 ml of water + 5% of palm olein diethanolamide biosurfactant, (P3) extract of neem plant seeds 100ml / 50 ml of water + 5% of palm olein diethanolamide biosurfactant, (4) young leaf extract and seeds of neem plant 100 ml / 500 ml of water + 5% palm olein diethanolamide biosurfactant, (5) old leaf extract and 100 ml / 500 ml neem plant seeds + 5% palm olein diethanolamide biosurfactant. The parameters observed consisted of (1) changes in morphology and physical pest after application. (2) Changes in morphology and pest behavior after application, mortality of cocoa fruit borer pests and (3) lethal time 50%
Application of Neem Extract plus Palm Olein Diethanolamide Biosurfactant in PBK pests

![Figure 1](image1.png)

**Figure 1.** Pest conditions before dripped of vegetable pesticides (active pests move)

![Figure 2](image2.png)

**Figure 2.** Application of vegetable pesticides to PBK pests (Application method is applied to the body of the cocoa fruit borer larvae (PBK), each of the larvae is dripped 3 times)

3. **Result and Discussion**

3.1. *Morphological changes and physical changes*

PBK pests which have been dripped by various treatments of neem extract and observed in H + 1 to H + 5 changes in pest appearance, both physically, behavior, color and others. These PBK pests die on average within 38 seconds up to 01.06 seconds, this shows that the treatment of neem extracts of various treatments is very effective for controlling PBK pests. Before dead PBK pests came into contact with neem extracts of various treatments, resulting in convulsive pests or uncontrolled behavior, not long after PBK pests died.

In the treatment without the application of neem extract, the pest conditions were 5 days after the application was still alive and active, there were even larvae that had turned into pupae, but for treatment P1, P2, and P3 the condition was dead, this indicates that neem extract with various treatment is effective for PBK pest control.

A few days after the application of the neem extract, there was a change in the color of the PBK pest, starting from brown and then turning into black. In addition, the body of the PBK pest which was originally rather large turned soft, while the small-sized PBK pests were hardened and stiff.
Figure 3. Observation of PBK Pest after H+5 Application

3.2. Morphological changes and pest behavior after application

Figure 4. Observation of dead larvae using a microscope

The condition of the damaged larvae is seen to be flattened/thin, and it also softens in the middle and hardens on the sides of its body, so that its body becomes damaged and peels.

3.3. Lethal Time 50%

Table 1. 50% Lethal Time of PBK Larvae

| Treatment                                      | Average |
|------------------------------------------------|---------|
| **P0 (Control / Without Treatment)**          |         |
| 1 Life                                        | 2 Pupa  |
| 3 Pupa                                        | 4 Die   |
| 5 Pupa                                        | -       |
| **P (Young Leaves Extract of Neem Plant)**    |         |
| 1:00:31                                       | 0:00:39 |
| 0:00:40                                       | 0:01:17 |
| 0:02:24                                       | 0:01:06 |
| **P2 (Old Leaves Extract of Neem Plant)**     |         |
| 1:00:36                                       | 0:00:29 |
| 0:00:44                                       | 0:00:37 |
| 0:00:17                                       | 0:00:33 |
| **P3 (Neem Seed Extract)**                    |         |
| 1:00:38                                       | 0:00:30 |
| 0:00:29                                       | 0:00:49 |
| 0:00:43                                       | 0:00:38 |
From the calculation results of the time of death of 5 treatments that have been applied, it shows that treatments P4 and P5 or leaf and seed mixture formulations produce the fastest death times compared to other pesticide formulations (P1 / P2 / P3). It can be concluded that the mixture of neem leaves and seeds has good pesticide content, that is, it is possible for the ingredients of each active ingredient of seeds and leaves to complement or react to each other well.

Cocoa fruit borer (CPB) generally attacks young cocoa fruits about 8 cm long. Stadium that causes damage is the larval stage. PBK larvae eat fruit flesh and food channels leading to seeds, but do not attack seeds. New symptoms appear from the outside when ripe fruit in the form of faded fruit skin and orange colored stripes and if shaken it does not ring. If split, the flesh will appear black, the seeds stick to each other in black, wrinkled, and light. As a result of this pest attack, the losses incurred can reach 80% of dry cocoa beans [9].

3.4. The content of neem leaves and seeds
The active ingredient in neem plants is azadirachtin, salanin, meliantriol, and neem, which are mainly found in seeds and leaves of plants. The azadirachtin substance is believed to have a killing power against insect pests. Neem leaves and seeds contain various chemical compounds, such as phenols, quinones, alkaloids and other nitrogen substances, acids and terpenes. Compounds that are believed to be bioactive ingredients of vegetable pesticides are neem (nimbinen), thionemon, meliantriol, azadirachtin, and salanin, which are chemical compounds from terpene groups [10], [11]. Said that the content of the active ingredients, neem seeds and leaves containing azadirachtin as the main active compound, meliantriol, salanin, nimbidin, and neem, which are the results of secondary metabolites from neem plants.

Azadirachtin is a contact poison, stomach poison, and pest repellent. Neem extracts made from leaves, flowers, and neem seeds can be used to control various types of pests, such as Helopelthis sp., long caterpillar, Aphis sp., Nilarvata sp., And Sitophilus sp. [10]. Azadirachtin compounds can inhibit the growth of pests insect, reduce appetite, reduce egg production and hatching, increase mortality, activate infertility (function as antifertile), and reject pests around the neem tree.

Azadirachtin contained in neem seeds acts as a substance that can inhibit the work of ecdysone hormone, which is a hormone that functions in the process of metamorphosis of insects. Insects will be disrupted in the process of changing the skin, or the process of change from egg to larvae, or from larvae to cocoons or from cocoons to adulthood. Usually, failure in this process often results in death (Kuba et al., 1986 in [12]).

Salanin acts as a decrease in appetite which results in insect destructive power is greatly reduced, even though the insects themselves are not dead. Insect pests that have been exposed to the application of neem seed powder will be sprawled and the destructive power is greatly reduced because insects are sick [11].

Meliantriol acts as a barrier to pest insects which results in insect pests being reluctant to approach plants due to meliantriol substances. Neem and Nimbidine act as anti-microbial organisms such as anti-virus, anti-bacterial, and anti-fungi. Neem and Nimbidine are very important and good for controlling plant diseases [11]. The application of neem seed extract can result in 60% mortality of red mite Tetanychus urticae, which is lower when compared to dicofol which reaches 81%; the same thing happened to predatory mites Amblyseius longispinosus [13].

Extracts from the leaves of the neem plant are reported to be able to control around 127 species of pests and are able to act as fungicides, bactericides, anti virus, nematocides and molluscicides [14]. The leaves of neem plants contain poison and are influential in the process of digestion of food, inhibiting intestinal contractions, so that the process of digestion of food cannot take place [15]. Besides being able to interfere with eating activities, poisons contained in the extracts of mimba leaves can also be absorbed through the body walls, in this case the leaves of the mimba leaves function as a contact poison [16].
3.5. Function of palm olein dea biosurfactant (dietanlamida)
One alternative that can be used for vegetable pesticides is to use diethanolamide surfactant (DEA) which is made from palm oil [17]. The advantage of using natural material based surfactants is that they are renewable and are more environmentally friendly in the production and application process than surfactants that use petroleum-based raw materials [18].

Based on research conducted by a research team of SBRC (Surfactant and Bioenergy Research Center) in 2012, DEA surfactants have the lowest surface tension (20.97 dyne / cm) compared to other surfactants such as APG (21-22 dyne / cm), ethoxylates (23-25 dyne / cm), and lauril betain (31.17 dyne / cm) which is widely used in the pesticide industry. Therefore, DEA surfactants have the potential to increase the effectiveness of insecticides [8]. Previous research conducted by [19] showed that DEA surfactant of palm olein was able to form good emulsions and increase the effectiveness of insecticides with active ingredients of buprofezin for brown planthopper pest control.

4. Conclusion
The best plant-based pesticide to control PBK pests are mixed vegetable pesticides from young seeds and leaves of Neem or P4 plants because the application results show that PBK pests are faster controlled or faster die. The reaction caused by PBK pests after dripped by vegetable pesticide liquid from a mixture of seeds and young leaves of the neem plant caused PBK pests to die within 24 seconds (the average time of 5 pests in one repetition). The reaction makes this pest move irregularly or convulsions and after that it dies.

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