

Cashew Nut Shell Liquid (*Anacardium occidentale*) as a Botanical Insecticide to Control *Helopeltis* sp on Cocoa plants

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ABSTRACT

Cashew nut skin is considered as waste, whereas cashew nutshell extract, or called CNSL (Cashew Nut Shell Liquid), has the potential as a botanical insecticide that can control insect pests. *Helopeltis* sp is a pest that often attacks cacao plants. The study aims to determine the effectiveness of cashew nutshell extract as a botanical insecticide to control *Helopeltis* sp. in cacao plants. The study used a randomized block design (RBD) with seven treatments and three replications. Testing CNSL on adult (imago) and pre-adult (nymph) insects. CNSL concentrations used are 0%, 3.125%, 6.25%, 12.5%, 25%, 50% and 100%. The results showed that cashew nutshell extract has strong toxicity. A concentration of 3.125% can kill 100% of the imago *Helopeltis* sp. (72 hours after application) for the nymph *Helopeltis* sp. (48 hours after application). LC50 values 24 hours after application for imago and nymph were 4.63% and 0.94%, and LC99 for imago and nymph was 42.62% and 23.89%. Furthermore, cashew nut extract can be used as a botanical insecticide to control other plant pests.

Keywords: Cashew Nut Shell Liquid (CNSL), *Helopeltis* sp, Cacao, Botanical Insecticide

INTRODUCTION

Cashew (*Anacardium occidentale*) is widely grown in Indonesia. Cashew nut shells are considered waste. In Indonesia, efforts to obtain Cashew Nut Shell Liquid (CNSL) production have not yet been developed and are unknown to the public CNSL. is a multipurpose material that is useful as industrial raw materials such as paint

(varnish), brake oil, shoe coatings, acid, and base resistant adhesives, ink making materials, wood preservatives, typewriter rollers, pesticides, paper making materials, fuels acid, textile material, anti-crust material, and others. CNSL application not only as biofertilizer but also as biopesticide for the control of pest and insects [1].

CNSL chemical content consists of 90% anacardic acid and 10% cardol. These compounds are toxic, which can cause inflammation. CNSL liquid consists of long-chain phenolic compounds (anacardic acid) and resorcinol derivatives, which are substituted by long-chain alkyl (cardol). Anacardic acid can inhibit the activity of pepsin, a thiol protease sulfhydryl enzyme. As a botanical insecticide, it acts as a larvicide, an acetylcholinesterase inhibitor, and an antioxidant [1]. Some uses of CNSL as a botanical insecticide include controlling *Aedes aegypti* larvae [3] *Tribolium castaneum* [4]. *Musca domestica* and *Chysomia megacephala*, *Anticarsia gemmatialia*, and *Spodoptera frugiperda* [5]. According to [6] even plant parts such as roots, leaves, stems also act as ovicides to control coconut root grub (*Leucopholis canephora*). Anacardic acid is a mixture of several closely related organic compounds, each consisting of salicylic acid substituted with an alkyl chain. It can be a medicinal remedy for alexeritic, amebicidal, gingivitis, malaria, and syphilitic ulcers. However, anacardic acid could be a potential target molecule with bactericide, fungicide, insecticide, anti-termite, and molluscicide [7].

Helopeltis sp. is a significant pest in cocoa cultivation in Indonesia, both in Sumatra or other regions [8]. This pest causes damage by piercing and sucking the juices and young shoots. The attack on the young fruit causes the death of the fruit, while the attack on medium-aged fruit results in the formation of strange fruit. In severe attacks, *Helopeltis sp.* can create disturbed plant health to reduce production by up to 60%. In addition to cocoa plants, the pest *Helopeltis sp.* also attacks several other plantation crops, namely on tea and cashew plants. The study aims to determine the effectiveness of cashew nutshell extract as a botanical insecticide to control the pest *Helopeltis sp.* in cacao plants. The cashew nutshell extract has

insecticide power against the insect pest *Helopeltis sp* and in the future can be further developed as a botanical insecticide on various insect pests.

Ladybug sucker and shoots *Helopeltis sp.* is the primary pest that ranks second after cocoa pod borer (CPB). Attack of *Helopeltis sp.* can cause a decrease in fruit production of around 50-60% (Wahyudi et al., 2008). Therefore this pest must also get serious attention. Need for proper pest control and environmentally friendly. So that the loss of results due to problems, *Helopeltis sp.* can be pressed and cocoa production for the better. Fruit-sucking pest *Helopeltis sp.* is a significant obstacle to cocoa cultivation in Indonesia. These pests cause damage by piercing and sucking fruit juices, as well as on young shoots. The attack on the young fruit causes the death of the fruit, whereas the attack on medium-aged fruit results in the formation of strange fruit. In severe attacks, *Helopeltis sp.* can cause disturbed plant health to reduce production by up to 60%. In addition to cocoa plants, the pest *Helopeltis sp.* also attacks several other plantation crops, namely on tea and cashew plants



Fig. Imago *Helopeltis sp.*

MATERIALS AND METHODS

The study was conducted in Gunung Kidul Regency, Yogyakarta. The materials used in this study include cashew nutshell extract (pericarp) and clean water, and cocoa fruit. The equipment used are an earthen cauldron for extracting cashew nut shells, a heating stove, filter paper for filtering the extraction results, filter paper, a plastic sprayer,

measuring cup, gauze cage, brush for catching insects, label paper, jars and gloves.

Extraction is used or traditionally to obtain cashew nutshell extract. Cashew nutshell extraction is done by heating. The cashew nut shell is placed in a clay cauldron, heated upside down over a fire. With heating, CNSL will come out and drip into the container. The CNSL will be used for

research. Tests were carried out on the insect phase *Helopeltis* sp imago and nymphs on cacao fruit. The cashew nut extract (CNSL) extract concentration series tested was 0%; 3.125%; 6.25%; 12.5%; 25%; 50% 100%. Observations at 24-hour intervals (24, 48, 72, 96) after applying

cashew nutshell extract (CNSL). Furthermore, to determine the level of CNSL sensitivity to mortality in *Helopeltis* sp., Analyzed with variance and probit analysis.

RESULTS AND DISCUSSION

Mortality imago Helopeltis sp.

The analysis of variance showed that the treatment of cashew nutshell extract was significantly different from the mortality of *Helopeltis* sp. The

results of the study of fundamental differences between treatments are presented in Table 1. below.

Table 1. Imago insect mortality *Helopeltis* sp. at several CNSL concentrations

concentrations (%)	Mean mortality of <i>Helopeltis</i> ± standard deviation (%)		
	24 hours	48 hours	72 hours
0,00	4,44 ± 1,93 e	4,00 ± 0 d	14,44 ± 3,33 b
3,125	36,67 ± 6,67 d	88,89 ± 1,92 c	100 ± 0 a
6,25	65,56 ± 18,96 c	92,11 ± 11,29 b	100 ± 0 a
12,5	83,33 ± 14,53 b	100 ± 0 a	100 ± 0 a
25	97,78 ± 3,85 a	100 ± 0 a	100 ± 0 a
50	100 ± 0 a	100 ± 0 a	100 ± 0 a
100	100 ± 0 a	100 ± 0 a	100 ± 0 a

The day after application (24 hours), there was *Helopeltis* sp. Insect death at all concentrations. Insect mortality increases with high CNSL concentration. In the following observation, the mortality of test insects was relatively high, at 88.89%. At CNSL concentrations of 12.5% and above have killed 100% of insects. Day 3, after treatment, all insects have died.

Epicarp has a hard consistency and clay. It is formed by a layer of the epidermis where there is a layer with elongated cells whose diameter normally leads to the surface layer at the bottom. Mesocarp is the thickest layer of the three layers of skin, is like a sponge, ballooned, like a wasp's house consisting of sclerenchyma. In this layer, channels contain 32% - 37% liquid CNSL (Cashew Nut Shell Liquid), which is sticky and thick. This liquid is boiling, spicy, irritant, and brown. Endocarp has a hard consistency and consists of

long-acting sclerenchyma cells that form a compact mass. Inside coated with a film layer

Cashew Nut Shell Liquid (CNSL) in cashew nut shells consists of 90% anacardic acid and 10% cardol. This liquid as an insecticide, bactericide, and fungicide [6]. CNSL is a potential raw material for insecticides to control larvae, pupae, and imago some insect pests. It can inhibit the development of larvae into pupae or the result of pupae into the imago.

CNSL testing as a vegetable insecticide on several pests, including *Cricula trifenestrata*, *Sitophilus* sp., and *Tribolium castaneum*. Test results show that CNSL can kill larvae and imago and can inhibit the development of pupae into imago with a percentage of more than 50% (Iskandar, 2002). Besides, CNSL can be used as a molluscicide to control golden snails (*Pomacea* sp.). The test results show that LC50 CNSL against gold snails is at a concentration of 13.09 ppm [7]. In rice bran, the CNSL concentration is 40%causes

maximum mortality on *Tribolium castaneum* [9]
Using 3% CNSL mixed with 4% soapberry, or

CNSL with detergent can control pests on soybean plants [10].

Table 2. Mortality of *Helopeltis* sp. pre-adult (nymphs) at various CNSL concentrations

concentrations (%)	Mean mortality of <i>Helopeltis</i> ± standard deviation (%)	
	24 hours	48 hours
0.00	4,44 ± 1,92 c	5,11 ± 1,62 b
3,125	77,78 ± 15,03 b	100 ± 0 a
6,25	97,78 ± 3,85 a	100 ± 0 a
12,5	96,67 ± 5,77 a	100 ± 0 a
25	100 ± 0 a	100 ± 0 a
50	100 ± 0 a	100 ± 0 a
100	100 ± 0 a	100 ± 0 a

note: The mean number followed by the same letter in the same column shows no significant difference according to the DMRT Test α 5%

In a cashew nutshell, the extract contains 90% anacardic acid and 10% cardol. The compound is irritant, which can cause inflammation [10] From the observations, sometimes after applying cashew

nutshell extract, the test insects reacted immediately to clean their bodies, especially on the antenna using their mouths. It shows that CNSL tends to be in contact with *Helopeltis* sp.

LC50 and LC99 cashew nut shell liquid (CNSL)

LC (Lethal Concentration) is the concentration of toxic material that can kill a percent of the population of test insects within a specific time. LC50 / LC99 is a concentration of poison that can

kill 50% / 99% of test insects within a particular time. The results of calculating LC values in table 3.

Table 3. LC₅₀ and LC₉₉ Cashew Nut Shell Liquid (CNSL) against Imago and Nymph *Helopeltis* sp. At 24 and 48 hours after application

LC (%)	LC value	<i>Helopeltis</i>		
		Imago		Nymph
		24 Hours	48 Hours	24 Hours
LC ₅₀	Max	5,45	1,38	1,75
	Mid	4,63	0,53	0,94
	Min	3,93	0,20	0,50
LC ₉₉	Max	59,11	40,59	37,64
	Mid	42,62	23,25	23,89
	Min	30,76	13,5	15,16

From table 3. above, it is known that at 4.63% CNSL concentration within 24 hours of observation after an application has been able to kill 50% of the tested *Helopeltis* imago, even at lower CNSL concentrations of 0.53% within 48 hours after application also has been able to kill

50% of the *Helopeltis* sp. imago. And for testing the nymph *Helopeltis* sp, at a concentration of 0.94% within 24 hours, it has been able to turn off 50% of the tested *Helopeltis*. *Anacardium occidentale* extrac is toxic against *Crocidolomia pavonana* larvae with an LC50 value of 0.30% six days after applicatioon. This extract has an

antifeedant effect and inhibits larval development time. Concentration range 0.16% - 0.45% reduces pupa weight, slows the emergence time of imago, slows first oviposition, reduces egg production, shortens the lifespan of female and male adults, shortens the oviposition period of female adults, and reduces fertility [9] This study about CNSL investigated the insecticidal activity of topically

applied dichloromethane and hexane extracts of CNSL against Fruit Fly (*Bractocera dorsalis*) on Papaya [11].

The LC99 value of cashew nutshell extract is relatively low, each under 50%. Thus, the cashew nutshell extract (CNSL) has extreme and effective

CONCLUSION

The results showed that cashew nutshell extract (CNSL) could be used as a vegetable insecticide and effectively killed *Helopeltis* sp. Cashew nut shell liquid has substantial toxicity. A concentration of 3.125% can kill 100% of the imago *Helopeltis* sp. (72 hours after application)

for the nymph *Helopeltis* sp. (48 hours after application). LC50 values 24 hours after application for imago and nymph were 4.63% and 0.94%, and LC99 for imago and nymph was 42.62% and 23.89%

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