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The Effectiveness of Tuba Root (Derris elliptica) and Gadung Tuber (Dioscoreahispida) to Control Bagworm Pests in Oil Palm

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ABSTRACT

This study aims to determine the ability of tuba root extract and gadung tuber to control bagworms in oil palm plantations. The study used a two factorial completely randomized design. The first factor is the type of insecticide, namely tuba roots and gadung tubers. The second factor is the concentration of 0%, 2.5%, 5%, 10% and 15%. Differences between treatments were tested with Duncan's multiple distances at the 5% significance level. The results showed that tuba root extract and gadung tuber extract effectively controlled bagworm pests. At a concentration of 10%, tuba root extract and gadung tuber could control these pests. This study concludes that the use of tuba and gadung root extracts can be used to control bagworms in oil palm plantations. The results of this study are expected to be useful in developing botanical insecticides to control other plant pests..

INTRODUCTION

Plant material is widely used as an insecticide to kill insect pests. Plants contain a wide variety of secondary metabolites. These secondary metabolites can be toxic, antifeedant, and repellent to insect pests. Some secondary metabolites from plants include flavonoids, phenols, and tannins, which can repel insects. Tuba plants (*Derris elliptica*) or jenu plants or called derris root, duvanivavalagi, or tuba root, have long been known by the public that it is used as a poison for hunting freshwater fish, swamps and ponds. This plant is a plant that propagates up to a length of approximately 15 meters. This plant can be found in humid places, on the forest edge, on banks of rivers, and sometimes in gardens or yards. This plant has several local names: *jenu* (Javanese), *tuwa* (Sundanese), and *thoba* (Madura). Tuba root extract can be a synthetic insecticide to kill *Spodoptera litura* larvae (Rattanapan et al., 2006). Tubal roots can inhibit the activity of the enzymes esterase and acetylcholinesterase. The crude tuba root extract of 1 g/l is very toxic to golden snails and kills 100% of golden snails (Wibowo et al., 2008). The flavonoid content of tuba root extract can play a role in controlling third instar *Aedes aegypti* mosquito larvae. The concentration of 2% tuba root extract can kill 100% of Aedes aegypti larvae in 24 hours (Sayono et al., 2010). It is known that the n-hexane fraction obtained from *Derris elliptica* root extract effectively controls Aedes larvae (Sayono et al., 2022). Tuba roots are also used to control the brown planthopper *Nilaparvatalugens* in rice plants (Kardinan et al., 2020).

Gadung (*Dioscoreahispida*) in the local language, also called tuber *Janeng*, is a type of sweet potato from the family Dioscoreaceae commonly found in tropical and subtropical areas around the world (Hamid et al., 2019). The gadung plant is taken for its tubers as a carbohydrate-rich material. However, gadung tubers are plants that contain toxic alkaloid compounds such as Dioscorides and dihydrodioscorine that can poison humans. Gadung tuber extract can act as a repellant in *Aedes aegypti* mosquitoes and larvicides. Gadung tuber extract at 100% concentration was able to resist 61.2% mosquito bites for 1 hour; 42.2% for 2 hours; 39.2% for 3 hours; 31.2% for 4 hours; 28.4% for 5 hours, and 26.3% for 6 hours (Handayani et al., 2017). Gadung extract can also be used as a rodenticide; at a concentration of 30%, it killed 50% of test rats (Posmaningsih et al., 2014). A mixture of gadung extract with tobacco, mojo, neem, galangal, ginger, and turmeric can kill caterpillars, grasshoppers, and crickets (Hasanah et al., 2012). Tuba root extract has high toxicity to kill the chilli mite *Polyphagortarsonemus latus* Banks with an LC50 value of 286.84 ppm with a threshold of 207.61–396.31 (Hasyim et al., 2018).

The bagworm is a pest that can cause a decrease in oil palm production. Several types of bagworms usually attack oil palm leaves, including *Mahasena corbetti*, *Metisa plana*, *Crematopishe pendula*, and *Clania* sp. Severe attacks of leaf-eating insects, namely bagworms, especially the Metisa plana species, can cause a loss of oil palm production by 43% (Johari et al., 2022). The larvae of caterpillars eat leaves on the top and bottom of the leaves used to hang in the bag. Bagworm damage to oil palm plants will be visible when 50% defoliation occurs. Control in the garden usually uses insecticides according to company standards. However, using insecticides can cause various impacts that are not good for the environment. Chemical pesticides are associated with human health hazards and are not environmentally friendly because they persist in nature for a long period (Sulaiman et al., 2019). In addition, pest control using synthetic chemical insecticides often has a negative impact on non-target insects and the environment (Pujiastuti et al., 2021). In addition, pesticides that are not sprayed based on pests that cross the critical population threshold result in suboptimal use of pesticides and have the potential to reduce yields (Abdullah et al., 2012). This study examines the effectiveness of tuba root extract and gadung tuber in controlling bagworm pests in oil palm plantations.

METODE

The materials used for this research were tuba roots and gadung tubers obtained from the land around the garden. The study was conducted using a 2×5 factorial Completely Randomized Design (CRD) with 3 replications. The first factor is the type of insecticide, namely tuba roots and gadung tubers. The second factor is the concentration of 0%, 2.5%, 5%, 10% and 15%. Extracts were made by grinding 250 grams of tuba roots and gadung tubers. Then made with concentrations of 0%, 2.5%, 5%, 10% and 15%. Extract application was carried out by spraying the extract on the 17th oil palm midrib which was attacked by the bagworm pest. Previously, the number of bagworms per midrib was calculated before and after treatment. Differences between treatments were tested with Duncan's multiple range test at the 5% level of significance.

HASIL DAN PEMBAHASAN

The bagworm is a pest that is quite detrimental in oil palm plantations. Therefore, the critical population of a pest The critical population of bagworms in oil palm plants can be seen in Table 1.

Table 1. Critical Population Level of Oil Palm Leaf-eating Caterpillars

Types of caterpillars that eat oil palm leaves	Critical Population (Number of caterpillars per sheath on oil palm leaves)
Mahasenacorbetti Tams	4-5
Metisa plana Walker	5-10
Crematopsyhe pendula	10-20

An understanding of population development plays an important role in pest control (Yu et al., 2022). The population of bagworms without control often increases to exceed the threshold, so monitoring and detection of oil palm bagworm populations are necessary to ensure proper planning of control measures (Ahmad et al., 2021). Table 1 shows that each type of bagworm has a different critical population. Critical population density is the number of pest populations that are considered necessary for control. For example, *Mahasenacorbetti* has a higher economic threshold than other bagworms. At the same time, the lowest is *Crematopsyhe pendula*. However, *Metisa plana* Walker cannot be ignored as it is one of the major leaf defoliators of palm oil in Malaysia (Mazuan et al., 2021).

Table 2. Bagworm Mortality per Midrib at various concentrations (%)

Extract	Concentration					
	Control (0%)	2,5 %	5%	10%	15%	Average
Tuba root	0	21.41	23.52	62.46	64.46	54.38 p
Gadung	0	17.80	35.71	62.50	66.66	56.53 p
Average	0 d	19.61 c	29.62 b	62.48 a	66.06 a	-

Table 2 shows that the test results of tuba root flour extract and gadung tuber have the same effect on the mortality of bagworms per midrib. With a concentration of 2.5%, tuba roots were able to kill 21.41% of bagworms per midrib. At a concentration of 10%, both tuba root extract and gadung tuber could kill more than 60% of bagworms. Tubal roots cause interference with enzyme activity. Tuba root extract has properties such as synthetic insecticides that can kill *Spodoptera litur*a caterpillars (Rattanapan et al., 2006). Methanol extract from the root of Derris fordii var. lucida has toxicity to 4th instar larvae of *Aedes albopictus*, *Aphis gossypii* Glover, *Aphis craccivora*, *Myzuspersicae*, second instar larvae of *Herse convolvuli* (L.), neonate larvae of *Scirpophagaincertulas* (Walker), second instar larvae *Pieris rapae* (L.) and adults *Phyllotretastriolata* (Fabricius) (You-Zhi et al., 2007). Rotenone also works by inhibiting the activity of the mitochondrial respiratory complex and causing cell death due to excess free radicals (Gupta, 2014). All parts of Derris have potential as insecticides. Three components are

identified from Derris root: rotenone, β-sitosterol and 6a, 12a-dehydrodegulin. Rotenone and 6a, 12a-dehydrodeguelin were able to kill the larvae of the yellow rice stem borer (*Scirphopagaincertulas*). Rotenone is also widely used to control pests on vegetables and fruits. As an insecticide, Derris can act as a contact and stomach poison. The tuba root can also act as a bioacaricide to control the yellow mite *Polypaghotarsonemus latus* on chilli plants with an LD50 of 286.84 and an LT50 of 9.98 hours (Hasyim et al., 2018).

Table 3. Effect of Concentration and Type of Vegetable Insecticide on Number of Affected Leaflets Per Midrib (Strand)

Extract	Concentration					
	Control (0%)	2,5 %	5%	10%	15%	Average
Tuba root	170.3	72.6	69.5	67.9	57.3	87.5 p
Gadung	170.0	68.0	65.5	64.0	58.4	85.4 p
Average	170.2 b	70.3 a	67.5 a	65.9 a	57.9 a	-

Table 3 shows that both tuba and gadung roots can suppress the development of pests. The decrease in the number of bagworms affects the number of affected leaflets. Although there was no significant difference in the number of affected leaflets at each concentration, the control using plant-based insecticides reduced the number of affected leaflets per midrib. This also occurred in the affected leaf area (Table 4).

Table 4. Effect of Concentration and Type of Vegetable Insecticide on Area of Affected Leaves Per Midrib (%)

Extract	Concentration					
	Control (0%)	2,5 %	5%	10%	15%	Average
Tuba root	98	47.66	38.06	24.06	14.95	44.55 p
Gadung	93	51.42	38.16	21.56	18.95	44.62 p
Average	95.5 b	49.54 a	38.11 a	22.81 a	16.95 a	-

Table 4 shows that tuba and gadung roots significantly affected the leaf area per midrib compared to no insecticide treatment (control). The affected leaf area was less than that without treatment (control). However, the tuba and gadung root treatments had no effect. Previous studies showed that *Dioscoreahispida* used as a traditional pest control agent in the Philippines, significantly inhibited larval moulting and reduced larval weight gain and high mortality in the diamondback moth larval stage (Banaag et al., 1997). Other studies have also shown that *D. hispida* can also be used to control *Rattus* sp. in the field (Sari et al., 2020). While tuba root extract with 100 g.l-1 water was the best concentration to control *H. armigera* larvae with the highest mortality time on the fourth day of 40% and total larval mortality of 87.5% (Rustam, Salbiah, et al., 2021). The application of tuba root vegetable insecticides also

controlled brown planthopper pests (over 80% mortality) in rice plants (Rustam, Fauzana, et al., 2021).

CONCLUSIONS

The results showed that tuba root extract and gadung tuber extract effectively controlled bagworm pests. At a concentration of 10%, tuba root extract and gadung tuber could control these pests. Utilization of tuba and gadung root extracts can be used as an effort to control bagworms in oil palm plantations. However, the researchers suggest that further tests regarding the application and appropriate dosage as an insecticide in the field should be carried out

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