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Effectiveness of Long Bean Plant Pest Control by Utilizing Cyanic Acid Content from Various Parts of Rubber Cassava Plants (*Manihot glaziovii*)

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Abstract
Crop production success depends on environmental conditions, such as rainfall, temperature, nutrition, and pest attacks. Pest attacks are one of Indonesia's main obstacles to cultivating long beans (Vigna unguiculata ssp. sesquipedalis). This study aims to evaluate the effectiveness of cyanide acid content from various parts of the rubber cassava plant (*Manihot glaziovii*) in controlling Aphis craccivora pests and its impact on the growth and yield of long beans. The study was conducted in Sragen and the Laboratory of the Faculty of Agriculture, Tunas Pembangunan University, Surakarta during September–December 2024 with a completely randomized block design (CRBD) with two factors, namely plant parts (leaves, tuber skin, and tubers) and extract doses (0, 10, 20, and 30 ml/plant). The results showed that tuber skin fermentation (B2) was the most effective in reducing the percentage of pest attacks (30.80%) and attack intensity (40.44%). The treatment dose of 30 ml/plant (K4) gave the best results in suppressing pest attacks and increasing growth and yield parameters, such as plant length (141.64 cm), fresh stalk weight (1905.77 g), and fruit weight (497.22 g). The bioactive content in cassava tuber skin has the potential to be a pest control agent and a plant growth stimulant. This study supports using environmentally friendly and sustainable local biopesticides to increase the productivity of long beans.

Keywords: biopesticides; long beans; pests; rubber cassava

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Introduction

Long beans (*Vigna unguiculata ssp. sesquipedalis*) are one of the important vegetable crops in Indonesia, with national production reaching 450,000 tons in 2023 (1). However, the productivity of this plant is often disrupted by pest attacks, which can cause significant economic losses for farmers. The demand for long beans in Indonesia continues to increase along with population growth and public awareness of the nutritional value of this vegetable. Based on data from the Ministry of Agriculture, the national production of long beans in 2020 reached 384,686 tons (2). This figure still does not meet the national demand, which is estimated to reach around 450,000 tons per year. The gap between production and demand highlights the need to increase the productivity of long bean farming in various regions. However, extreme weather, pest attacks, and limited productive land remain significant challenges in meeting market demand.

Long bean cultivation still experienced many obstacles, both in terms of environmental factors and pest attacks (3). Pest control in long bean plants generally still relies on synthetic pesticides. Although effective, excessive use of chemical pesticides can cause various problems, such as pest resistance, environmental pollution, and hazardous residues in agricultural products (4). Pesticide application plays a key role in the environment (5), therefore, more environmentally friendly and sustainable pest control alternatives are needed.

One promising approach is the use of natural compounds from plants as biopesticides. Cassava plants are known to contain hydrocyanic acid (HCN) compounds that have the potential to be used as botanical insecticides (6). The cyanogenic glycoside composition therein raises concerns regarding potential toxicity due to the release of hydrogen cyanide (HCN) during metabolism (7). Cyanide, with varying concentrations, is found in various parts of the cassava plant, such as leaves, cassava skin, and tubers. The insecticidal component, especially in cassava leaves, is hydrogen cyanide, which is released when the cells burst (8). Several previous studies have shown the effectiveness of cassava plant extract in controlling various types of pests (9). The oil at 1 and 0.5% concentrations gave 100% pest mortality within 24 and 48 hours of treatment, respectively. However, research on the effectiveness of the cyanide content of cassava plants for controlling pests in long bean plants is still limited.

This study aims to assess the effectiveness of using cyanide acid extracted from parts of rubber cassava plants as a pest control agent on long bean plants. In addition, it also determines the optimal dose of cyanide acid to achieve effective pest control without harming long bean plants. The results of this study are expected to provide an alternative to more environmentally friendly pest control for long bean farmers while utilizing the potential of rubber cassava plants as a source of local biopesticides. In addition, this study can contribute to developing more sustainable integrated pest control strategies in Indonesia's agricultural systems.

Materials and Methods

This research was conducted in Kragilan Village, Gemolong District, Sragen Regency, and in the Laboratory of the Faculty of Agriculture, Tunas Pembangunan University, Surakarta, in September - December 2024. The equipment utilized in this study comprised a scoop, writing instruments, a hand sprayer, 1.5-liter mineral water bottles, dishwashing detergent, a blender or grinder, buckets, and a digital scale. The materials employed included long bean (*Vigna unguiculata*) seeds, cassava (*Manihot glaziovii*) leaves from rubber plantations, cassava peels from rubber plantations, cassava tubers from rubber plantations, farmyard manure, 300 mL of molasses, and 90 mL of EM4 (Effective Microorganisms). The cassava used was the bitter variety, locally known as the "karet" type, which was obtained from fields surrounding the research site.

This study used the CRBD method with two factors and three replications. The first factor was the treatment of fermentation of cassava plant parts (B): B1: rubber cassava leaves, B2: rubber cassava tuber skin, B3: rubber cassava tubers. For the second factor, we used the dosage of fermented pesticides from cassava plants (K), consisting of 4 levels: K1: 0 ml/plant, K2: 10 ml plant, K3: 20 ml/plant, K4: 30 ml/plant. The making of cassava extract uses a fermentation process with finely ground ingredients (leaves, tuber skin, cassava tubers) plus 100 ml of MOL, 30 ml of EM4, and 1 liter of water, then fermented for 14-21 days (a sign of successful fermentation is the smell of alcohol). The planting process is carried out for about 50 days. Pest control is carried out every 3-4 days by mixing cyanide acid from cassava plants with water in a ratio of 1:10 and adding 2 ml of dishwashing soap per 1 liter. Treatment with watering is carried out once a week during the planting period. Data were analyzed using two-way analysis of variance (ANOVA). If significant differences exist, it is continued with Duncan's Multiple Range Test (DMRT) at the 5% level.

Result and Discussion

Sustainable agricultural development requires a deep understanding of the factors influencing plant growth and pests' resistance. In agriculture, pest control is one of the most critical needs to ensure the production of quality crops (10). The use of rubber cassava has so far been limited to use as animal feed and research. (11) Shows the fermentation of rubber cassava leaves as animal feed. The data presented in these three tables provide a comprehensive picture of the effects of two different treatments on plants: the fermentation of cassava plant parts and the administration of cassava plant extract doses. The first table details the effectiveness of using rubber cassava plant parts as pest control. The second table contains growth parameters such as plant length, fruit length, fresh stalk weight, and dry stalk weight, key indicators of successful cultivation. Meanwhile, the third table presents the parameters of the yield components that focus on the number of fruits and fruit weight.

Table 1. Effectiveness of Pest Control (*Aphis craccivora*) by Utilizing Cyanide Acid Content from Parts of Rubber Cassava Plants (*Manihot Glaziovii*)

Treatments	Attack percentage (%)	Intensity of attack
Fermentation of Cassava Plant Parts (B)		
B1 (leaf)	54,90 a	50,51 a
B2 (tuber skin)	30,80 b	40,44 b
B3 (tuber)	59,90 a	55,30 a
Cassava Plant Extract Dosage (K)		
K1 (0 ml/ plant)	20,45 a	15,21 a
K2 (10 ml/plant)	20,42 a	15,95 a
K3 (20 ml/plant)	19,74 b	15,15 a
K4 (30 ml/plant)	18,72 b	14,93 a

Note: The result of the number followed by the equal alphabet in each experiment indicates that there is no significant difference in the DMRT α 5% test

Fermentation of cassava plant parts showed a significant effect on reducing *Aphis craccivora* pest attacks. Treatment B2 (tuber skin) had the highest effectiveness in reducing both the percentage (30.80%) and intensity of attacks (40.44%) compared to B1 (leaves) and B3 (tubers), which showed higher attack rates and were not significantly different from each other. This indicates that cassava tuber skin contains bioactive compounds that are more effective in inhibiting the development of these pests. Meanwhile, in the extract dose treatment, the K4 treatment (30 ml/plant) proved to be the most effective in reducing the percentage (18.72%) and intensity of attacks (14.93%). This effectiveness is higher than that of K1 (control) to K3, which showed a gradual decrease as the dose increased. This indicates that increasing the dose of cassava extract can strengthen the repellent or toxicity against pest attacks.

Figure 1. Aphis pest attack on leaves

Figure 2. Aphis pest attack on the stem

The primary pest observed in this study was aphids (Aphis craccivora). Aphids are the primary pests that attack long bean plants most often. Aphid pest attacks can cause a decrease in plant productivity if left untreated (12). These pests suck the liquid from the plant to obtain the nutrients it needs. Aphids feed on phloem sap with highly efficient mouthparts modified into long, flexible stylets (13). Symptoms of attack are generally seen on flower buds and young leaves, which can cause young leaves to curl and failure to bloom. In addition, aphids can interfere with photosynthesis due to the appearance of sooty mold, which is characterized by a blackish color on the leaves and stems of bean plants. Controlling aphids in addition to using pesticides can be done by planting aromatic plants such as basil to reduce the intensity of attacks (14).

Table 2. The Effect of Cassava Fermentation Extract Treatment and Dosage on Long Bean Plant Growth Parameters

Treatment	Growth Parameters			
	Plant length (cm)	Fruit length (cm)	Fresh weight (gr)	Dry weight (gr)
Fermentation of Cassava Plant Parts (B)				
B1 (leaf)	138,41a	39,25a	1722,75a	456,58a
B2 (tuber skin)	164,53b	43,06b	1908,59a	497,41b
B3 (tuber)	121,66a	41,20b	1887,99a	483,07b
Cassava Plant Extract Dosage (K)				
K1 (0 ml/ plant)	123,33a	38,06a	1736a	453,99a
K2 (10 ml/plant)	128,99a	42,81b	1881,11b	490,33b
K3 (20 ml/plant)	122,21a	41,12b	1837,88b	474,77a
K4 (30 ml/plant)	141,64b	40,08b	1905,77c	497,22b

Note: The result of the number followed by the equal alphabet in each experiment indicates that there is no significant difference in the DMRT α 5% test

Observation results on growth parameters, the treatment of tuber skin fermentation (B2) showed the most optimal results, especially in plant length (164.53 cm), fruit length (43.06 cm), and dry stubble weight (497.41 g). This shows cassava tuber skin can provide nutrients or growth-stimulating compounds better than the leaves (B1) or tubers (B3). In terms of extract dosage, the K4 treatment (30 ml/plant) generally also gave the best results in plant length (141.64 cm) and fresh stubble weight (1905.77 g), as well as dry stubble (497.22 g). The highest dose (30 ml) can increase plant biomass productivity. This finding indicates that the highest dose treatment (30 mL) significantly affected plant growth, as evidenced by the increase in overall biomass productivity. The higher dose likely provided a greater concentration of nutrients, growth-promoting compounds, or beneficial microorganisms (depending on the treatment type), enhancing physiological processes such as photosynthesis, nutrient uptake, and cell division.

The highest fruit length was found at the K2 dose (42.81 cm), which indicates that this parameter is influenced by factors other than dose, or that there is an optimal threshold at a certain point. In line with the research (15) This utilizes cassava skin as organic fertilizer, showing that it can be used as fertilizer. The organic carbon content in cassava skin can increase the fertility of the planting medium (16).

Meanwhile, there was a different pattern in the treatment of cassava plant extract dosage (K). The plant length (cm) of the K4 treatment showed the highest plant length of 141.64 cm, significantly different from K1, K2, and K3, which had plant lengths ranging from 122 cm to 128 cm. For the weight of fresh stover (gr), a significant difference was found between the K1, K2, K3, and K4 treatments, with the highest value in K4 of 1905.77 gr. This is because the C/N ratio content in cassava skin contains around 30.13% (17)The Carbon-Nitrogen (C/N) ratio in soil and organic matter, especially in organic fertilizer, has a significant relationship with crop yield. However, in dry biomass weight (gr), K4 showed the highest weight of 497.22 gr, followed by K2 of 490.33 gr. Dry biomass weight is one of the critical yield components in a study. (18).

Table 3. The Effect of Cassava Fermentation Extract Treatment and Dosage on Plant Yield Components

Treatment	Quantity of fruit (qty)	Fruit weight (g)
Fermentation of Cassava Plant Parts (B)		
B1 (leaf)	22,33a	456,58a
B2 (tuber skin)	24,21b	497,41b
B3 (tuber)	21,58a	483,25b
Cassava Plant Extract Dosage (K)		
K1 (0 ml/ plant)	22,37a	453,99a
K2 (10 ml/plant)	21,22a	471,77b
K3 (20 ml/plant)	22,44a	474,77b
K4 (30 ml/plant)	23,52b	497,22c

Note: The result of the number followed by the equal alphabet in each experiment indicates that there is no significant difference in the DMRT α 5% test

The tuber skin fermentation (B2) also produced the highest number and weight of long beans, 24.21 pieces and 497.41 grams, respectively, significantly different from B1 and B3. This reaffirms that the tuber skin has more potential content in increasing harvest yields. Research (19) Also mentioned that using cassava peel substrate can increase the production of P. ostreatus fungus. Regarding extract dosage, the K4 treatment (30 ml/plant) showed the best results with 23.52 fruits and a bean weight of 497.22 grams. This indicates that the 30 ml/plant cassava extract dose effectively supports optimal fruit formation and filling. Although the difference in the number of fruits between treatments is not too significant, the difference in bean weight shows an increase in the harvest quality. Research (20) Also showed that cassava skin can reduce rodent attacks on peanut commodities.

Conclusion

The treatment of cassava tuber skin fermentation (B2) was the most effective in suppressing Aphis craccivora pest attacks, by reducing the percentage of attacks by 30.80% and the intensity of attacks by 40.44%. This treatment also gave the best results in growth parameters and plant yields, such as plant length reaching 164.53 cm, fruit length 43.06 cm, dry stalk weight 497.41 grams, number of fruits 24.21 fruits, and fruit weight 497.41 grams. In addition, the extract dose of 30 ml per plant (K4) also gave the most optimal results in supporting plant growth and yields, marked by fresh stalk weight of 1905.77 grams, dry stalk weight of 497.22 grams, and fruit weight of 497.22 grams. The combination of B2 treatment and K4 dose shows that the cyanide acid content of cassava tuber skin is effective as a botanical biopesticide and is able to significantly increase the productivity of long bean plants, so that it can be an environmentally friendly pest control solution and support sustainable agriculture.

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