

Effectiveness of Ginger Extract (*Zingiber officinale*) and Turmeric (*Curcuma domestica*) against the mortality of the Armyworm (*Spodoptera litura*)

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ABSTRACT

Some types of plants can serve as plant-based insecticides. Ginger (*Zingiber officinale*) and Turmeric (*Curcuma domestica*) are ingredients that are often used as pesticides on various plant pests. *Spodoptera litura* itself is a pest that is quite annoying in various plants. The study aimed to examine ginger (*Zingiber officinale*) and turmeric (*Curcuma domestica*) extracts as insecticides to control armyworms (*Spodoptera litura*). The research was carried out in Pelemsari Village, Prenggan, Kotagede, Yogyakarta from May to June 2022. The study used a Complete Random Design (RAL) with 2 factors. The first factor is the type of extract, namely ginger and turmeric. The second factor is the concentration of the extract which consists of 3 levels, namely 20%, 40%, 60% and control, each treatment is repeated 3 times. To find out the real difference between the data treatments, the observation results were analyzed with *Duncan's Multiple Range Test* (DMRT) at the real level of 5%. Ginger and turmeric extracts at a concentration of 20% have been able to control *S. litura* larvae. Ginger extract is more effective compared to turmeric extract based on the mortality test, efficacy, death rate, and feed spoilage rate of *S. litura* larvae. The research is still in the experimental stage in the laboratory and needs to be tested in the field to get an effective dose for armyworms.

Keywords: *Zingiber officinale*, *Curcuma domestica*, Plant-based insecticides, *Spodoptera litura*

INTRODUCTION

Armyworm (*Spodoptera litura*) is a pest that is quite annoying to various types of plants such as beans, tomatoes, tobacco, chili peppers and so on. *Spodoptera* is a polyphage and quite voracious insect. This pest is spread across various countries in Southeast Asia. Yield losses due to these pest attacks can cause crop failure. This pest control is

generally carried out using synthetic chemical insecticides that provide many negatives to natural conditions

One of the controls that is widely carried out is the use of plant-based insecticides. Plant insecticides are natural ingredients that are toxic and can inhibit growth and development, interfere

with behavior, inhibit reproduction, affect hormones, inhibit eating, make infertility, as an attractant, repellent, and other activities that can affect insect pests. The use of plant-derived ingredients can be used as an alternative to the use of artificial insecticides, which are often called plant-based pesticides or bioinsecticides. The use of plant-based insecticides as an environmentally friendly alternative to insect control because of its low persistence rate, easily decomposing residues in nature, and safer for non-target organisms.

Ginger plants (*Zingiber officinale*) and Turmeric (*Curcuma domestica*) are plants that are widely found in Indonesia. Apart from being a spice and medicinal plant, both can be used as vegetable insecticides. *Zingiber officinale*,

commonly known as ginger, has been studied for its potential use in controlling insect pests in agriculture. The active compounds in ginger, such as gingerol, shogaol, and zingerone, have been shown to have insecticidal and repellent properties. Ginger contains phenolic compounds that are antioxidant, also contain phytochemicals such as alkaloids, flavonoids, phenolics, triterpenoids and saponins (Sinha & Ray, 2024). Red ginger extract can be used as a natural larvicide of *Aedes albopictus* at a concentration of 8% lethal larvae within 6 hours after treatment (Qatrinida et al., 2021). This study wants to examine the effectiveness of ginger extract and turmeric on the mortality of *Spodoptera litura* larvae in oil palm plants

MATERIALS AND METHODS

The research was carried out in Pelemsari Village, Prenggan, Kotagede, Yogyakarta for 1 month, at an altitude of 200 spl and an average temperature of 290C and an average humidity of 85%. The ingredients used are ginger rhizomes, turmeric, and the third instar larva of *Spodoptera litura*. The materials used are polybags with a capacity of 2 kg and oil palm plants that are 4 months old

The experiment used a factorial complete randomized design, with two treatments, namely concentration and type of extract. The concentrations include 20%, 40%, 60% and control, while the types of extracts used are

ginger and turmeric. Each treatment was repeated 3 times. Each treatment was infested with 10 instar insect larvae 3.

The extract is made by weighing ginger and curcuma rhizomes, 200gr each, with 200ml of water, blended. The result of the extract is considered to be 100% concentration. Dilution is carried out according to the desired concentration. The dilution results are used to spray the leaves with insects. Observation is carried out every day for 7 days to see mortality and symptoms of damage that occurred.

RESULTS AND DISCUSSION

Mortalitas

Based on the results of the variegated fingerprint test, it was shown that there was no real difference between the treatment of ginger and turmeric on the mortality of *S. litura*, this can be found by conducting a statistical treatment test of

Duncan's Multiple Range Test (DMRT) with a real level of 5%. However, there was a very significant effect on the mortality percentage of *S. litura* larvae between ginger and turmeric extract treatment with control. This can be seen in table 1.

Table 1. Mortality of *S. litura* after application of extract

Extract	Concentrace	Mortalitas (%)							Average
		1	2	3	4	5	6	7	
Ginger	20%	20.00a	50.00a	66.67a	93.33a	100.00b	100.01b	100.02b	75.71a
	40%	26.67a	60.00a	76.67ab	96.67a	100.00b	100.01b	100.02b	80.00a
	60%	30.00a	53.33a	83.33ab	100.00b	100.00b	100.01b	100.02b	80.95a
Turmeric	20%	33.33a	35.00a	55.00ab	85.00a	100.00b	100.01b	100.02b	72.62a
	40%	26.67a	46.67a	76.67ab	93.33a	100.00b	100.01b	100.02b	77.62a
	60%	16.67a	60.00a	76.67b	96.67a	100.00b	100.01b	100.02b	78.57a
Control		0.00c	0.00c	0.00c	0.00c	0.00c	0.00c	0.00c	0.00c
Average		21.90a	43.57ab	62.14bc	80.71c	85.71c	85.71c	85.71c	(-)

Description: On the same letter shows no real difference based on DMRT at 5%

Table 1 shows that there is no difference between the types of extract materials used. Ginger and turmeric extracts can result in the death of *S. litura* larvae one day after application and increase up to five days. By the fifth day all the larvae had died. The mortality graph can be seen in Figure 1 below

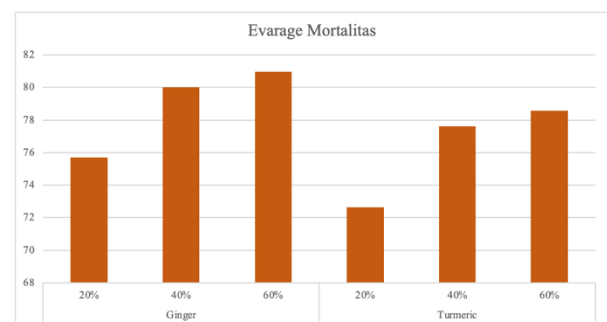


Fig 1. Evarage *S. litura* mortality after extract application

Speed of Death

Table 2 shows that ginger extract and turmeric extract have no effect on the speed of death of *S. litura*. This can be found by conducting a statistical

treatment test of Duncan's Multiple Range Test (DMRT) with a real level of 5%.

Table 2. Rate of death rate of *S. litura* after application of botanical insecticide

Extract	Concentrace	Speed of Death (%)							Average
		1	2	3	4	5	6	7	
Ginger	20%	4.80a	14.40a	12.00a	25.60a	8.00a	0.00b	0.00b	9.26a
	40%	6.40a	16.00a	12.00a	19.20a	4.00a	0.00b	0.00b	8.23a
	60%	6.40a	12.80a	21.60a	16.00a	0.00b	0.00b	0.00b	8.11a
Turmeric	20%	3.20a	11.20a	16.80a	28.80a	12.00a	0.00b	0.00b	10.29a
	40%	7.20a	8.00a	21.60a	16.00a	8.00a	0.00b	0.00b	8.69a
	60%	8.80a	11.20a	12.00a	19.20a	4.00a	0.00b	0.00b	7.89a
Control		0.00c	0.00c	0.00c	0.00c	0.00c	0.00c	0.00c	0.00c
Average		5.26a	10.51ab	13.71bc	17.83c	5.14a	0.00d	0.00d	(-)

Description: On the same letter shows no real difference based on DMRT at 5%

In table 2, it can be seen that there is no real effect between the type of extract and the speed of larval death, when viewed at the observation 4 days after the application of ginger extract, the speed of death is faster than that of turmeric extract. For more clarity on the speed of death can be seen in the image below.

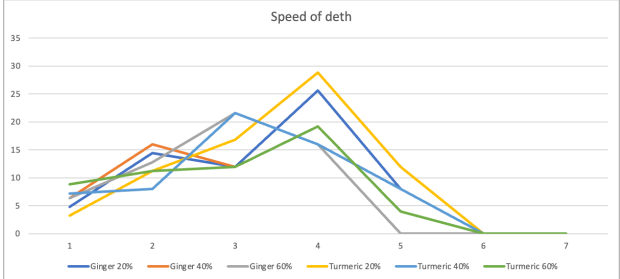


Fig 2. *S. litura* mortality rate graph after extract application

Damage Level

Table 4 shows that ginger and turmeric extracts do not differ significantly between treatments on the level of feed spoilage. This

can be found by conducting a statistical treatment test of Duncan's Multiple Range Test (DMRT) with a real level of 5%.

Table 2. Rate of leaf damage due to *S. litura* infestation after application of the extract

Extract	Concentrace	Damage (%)							Average
		1	2	3	4	5	6	7	
Ginger	20%	0.48a	1.00a	1.70a	2.03a	2.15ab	2.15ab	2.15ab	1.67a
	40%	0.49a	0.97a	1.67a	1.97a	2.06ab	2.06ab	2.06ab	1.60a
	60%	0.61a	1.24a	1.70a	1.88a	1.88a	1.88a	1.88a	1.58a
Turmeric	20%	0.73a	1.36a	1.79a	2.18a	2.42b	2.42b	2.42b	1.90a
	40%	0.5a	1.09a	1.67a	1.09a	2.27ab	2.27ab	2.27ab	1.75a
	60%	0.64a	1.12a	1.73a	2.03a	2.15ab	2.15ab	2.15ab	1.71a
Control		1.18b	2.06b	2.70b	3.30b	4.94c	4.48c	4.91c	3.23a
Average		0.66a	1.26ab	1.85bc	2.21c	2.41c	2.49c	2.55c	(-)

Description: On the same letter shows no real difference based on DMRT at 5%

Table 4 shows that higher the concentration of the extract leads to a decrease in the level of damage to the leaves. A concentration of 20% provides the greatest damage result compared to a concentration of 60%, both in ginger and turmeric extracts. For more clarity, you can see the picture below.

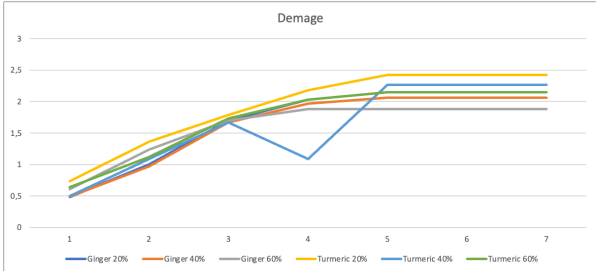


Figure 3. Rate of leaf damage after application of ginger and tumeric extract

Based on the *Duncan's Multiple Range Test* (DMRT) treatment test with a real level of 5%, it was shown that there was no significant difference between the treatment of ginger and turmeric extracts on mortality, mortality rate, efficacy of

vegetable insecticides, and the rate of feed damage due to *S. litura*.

One to seven days after the application of ginger and turmeric extracts, the larval maturity is increasing. This is in accordance with the opinion

of Sutoyo and Wirioadmodjo (1997) that the higher the concentration, the more the amount of poison that hits the skin of the insect, so that it can inhibit growth and cause more pest deaths as well.

Ginger and turmeric extracts have a high efficacy value, where on average one to seven days after treatment the value is more than 50%. As stated by Natawigena (1994), insecticides are said to be able to control pests if they have an efficacy greater than 50%.

The results of testing the efficacy of ginger and turmeric extracts on the mortality percentage of *S. litura* increased along with the increase in concentration in each treatment. At the observation of the 4th day after application, the death rate of ginger extract was faster than that of turmeric extract.

The results of statistical analysis showed that the higher the concentration in the extract, the lower the level of damage to the feed, the damage to the leaves applied with ginger extract with a concentration of 20% was greater than the leaves applied with ginger extract with a concentration of 60%. Likewise, the damage to feed applied with 20% turmeric extract suffered greater damage than feed applied with turmeric extract with a concentration of 60%.

This is suspected because the compounds in ginger are *flavonoids* and *terpenoids* which are stomach toxins that affect the digestive system, *phenols* which are neurotoxins that can inhibit larval growth, and there are also *oleoresin* compounds that cause a spicy taste as antifeedants which causes the larvae to stop feeding activities, plays a more active role in inhibiting larval activity compared to the compounds contained in turmeric, namely *curcumin* which inhibits larval growth, *tannins* which are stomach toxins that affect the digestive system, and *essential oils* that repel the presence of larvae. The use of ginger extract in *Spodoptera litura* can inhibit egg spawning, prolong the hatching period, and also affect the emergence of larvae (Hamada et al., 2018) The use of red ginger can also be used to control *Aedes agypti* mosquitoes (Anwar et al., 2018) This is in accordance with the statement of Nandini (1989) that the compounds and active ingredients found in plants, namely *flavonoids* that are stomach toxins,

if more and more of them are found in the body, can inhibit growth and cause more deaths of *S. litura*.

Turmeric is also toxic to insects because it contains tumeric compounds. Tumeric itself contains various bioactive components such as essential oils, alkaloids, flavonoids, saponins that have the potential to kill mosquito larvae (Susilowati et al., 2021) Turmeric is also a repellent for cockroach insects *Periplaneta americana* (L.), *Blattella germanica* (L.) and *Neostylopyga rhombifolia* (Stoll) in laboratory (Thavara et al., 2007). Turmeric powder and its derivatives caused 10–20% mortality in third instar *Trichoplusia ni* at a very low dose (10µg/larva) in Brassicae plant (De Souza Tavares et al., 2016). Campuran ekstrak *Curcuma domestica* dan *Annona squamosa* menyebabkan imago *Spodoptera litura* tidak berkembang sempurna, pengurangan ukuran imago, serta imago tidak mampu menghasilkan telur (Taufika et al., 2020)

Although there was no significant difference between the treatment of ginger and turmeric extracts on the mortality of *S. litura*, the efficacy of vegetable insecticides against *S. litura*, the rate of death of *S. litura*, and the rate of feed spoilage of *S. litura*, the two ingredients had different secondary metabolite compounds in inhibiting larval activity so that ginger played a more active role compared to the extract turmeric.

The death of *S. litura* caterpillars does not occur immediately at the time of application, because in the body of *S. litura* caterpillars takes place a biological process that takes several days from the occurrence of infection with *flavonoid* compounds, *phenols*, *oleoresins* and *essential oils* in ginger, as well as the content of *curcumin*, *tannins*, and *essential oils* on turmeric until the *S. litura* caterpillar dies. The process begins with the ingestion of the compound into the intestines of the caterpillar. In the intestines, an enzymatic reaction occurs that is alkaline in nature that causes compounds to dissolve and are able to penetrate the intestinal wall into the body cavity and attack vulnerable tissue cells. So the use of this plant-based insecticide only showed results a few days after application. During this interval, although the

feeding activities carried out by the caterpillars decrease, they can still cause leaf damage.

CONCLUSION

The result of research and discussion can be concluded that Ginger and turmeric extracts at a concentration of 20% have been able to control *S. litura* larvae. Ginger extract is more effective compared to turmeric extract based

on the mortality test, efficacy, death rate, and feed spoilage rate of *S. litura* larvae. The research is still in the experimental stage in the laboratory and needs to be tested in the field to get an effective dose for armyworm.

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