International Journal of Social Science, Educational, Economics, Agriculture Research and Technology (IJSET) | ISSN (e) : 2827-766X
Volumes 1 No. 1 (2021)

STOMACH POISON RESPONSE TO KIPAHIT LEAF EXTRACT Tithonia diversifolia AGAINST FALL ARMYWORM LARVAES Spodoptera frugiperda J. E. Smith.

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Received	: 01 November 2021	Published	: 30 December 2021
Revised	: 10 November 2021	DOI	: https://doi.org/10.54443/ijset.v1i1.1066
Accepted	: 25 November 2021	Publish Link	: https://www.ijset.org/index.php/ijset/index

Abstract

Corn (Zea mays L.) is an important food crop in Indonesia, whose production is threatened by the invasive pest Spodoptera frugiperda (Fall Armyworm/FAW). This pest causes significant damage to crops and drastically reduces yields. Excessive use of chemical insecticides to control FAW has caused various negative impacts. Therefore, the development of plant-based botanical insecticides is a safer and more sustainable control alternative.The purpose of this study was to observe the toxicity response of stomach poison extract of T. diversifolia kipahit leaves to S. frugiperda larvae. This study was conducted in the laboratory of the Faculty of Agriculture, Islamic University of North Sumatra, Jl. Karya Wisata Gedung Johor. Medan Johor District, Medan City, North Sumatra. With an altitude of ± 25 m above sea level (meters above sea level) with flat topography. This study was conducted in the laboratory using a Non-factorial Completely Randomized Design using several treatments, namely K0: Control, K1: 0.1%, K2: 0.2%, K3: 0.3%, K4: 0.4%, and K5: 0.5%. The stomach poison of T. diversifolia kipahit leaf extract had a very significant effect on the mortality of S. frugiperda larvae, showing that the highest mortality was at the K5 concentration (0.5%) reaching 23-90% at 2-8 HSA and the lowest percentage of larval mortality, namely the K0 concentration (control), had a mortality of 3-8% at 6-8 HSA.

Keywords: ***FAW, Stomach Poison, and Kipahit Leaf Extract***

Introduction

Corn is an important food crop, being the third most important staple food in the world after wheat and rice (Pasta et al., 2015), and the second most important in Indonesia after rice (Kartika, 2019). Demand for corn continues to increase, both for consumption and industry (Iriany et al., 2011). However, corn production is threatened by the invasive pest Spodoptera frugiperda (FAW), which originated in the Americas (Nonci et al., 2019) and has spread widely in Africa (Goergen et al., 2016; Abrahams et al., 2017; Sisay et al., 2019) and Indonesia, including West Sumatra, Lampung, Bandung, and Garut (Nonci et al., 2019; Maharani et al., 2019). Spodoptera frugiperda, also known as Fall Armyworm (FAW), is a significant pest of corn plants and is now widespread in various tropical and subtropical regions. This insect undergoes complete metamorphosis (egg, larva, pupa, and adult) and exhibits high adaptability and dispersal capabilities. Its larvae damage leaves, stems, and even corn cobs, producing characteristic burrows and sawdust-like debris. In severe cases, the damage can lead to defoliation and plant death. In North Sumatra, corn production decreased from 1,965,444 tons (2020) to 1,724,398 tons (2021), allegedly due to FAW attacks (BPS, 2022; BBPOPT, 2020). This pest damages corn plants from the larval stage by boring into and eating plant tissue, so effective and environmentally friendly control is required. The use of chemical insecticides remains the primary choice for farmers, but their use has negative impacts such as pest resistance, resurgence, loss of natural enemies, environmental pollution, and health risks (Laba, 2010;

Oktofa, 2016). Therefore, it is necessary to develop alternative control methods using safer botanical insecticides (Ridhwan & Isharyanto, 2016). Botanical insecticides are derived from plants that produce secondary metabolites, such as flavonoids and alkaloids (Junita, 2016), and have been commercialized by several companies (Directorate General of Agricultural Infrastructure and Facilities, 2020). One potential plant is kipahit (Tithonia diversifolia), as its leaves contain bioactive compounds (Taofik et al., 2010). Soxhletation is a method of extractionplants using a Soxhlet apparatus. This Soxhlet method is an extraction method that uses heating (Anam et al., 2014) and soaking the sample in acetone solvent. This Soxhlet method causes the cell walls and membranes to break down due to the pressure difference between inside and outside the cell. Thus, secondary metabolites in the cytoplasm will dissolve into the organic solvent. This solution then evaporates upward and passes through an air cooler that condenses the vapor into droplets that are then collected again. When the solution passes the limit of the side pipe hole of the Soxhlet, circulation will occur. Repeated circulation produces a good extract (Muhammad, 2017). Several studies have shown the effectiveness of kipahit extract against various pests: the fly Chrysomya bezziana (Wardhana & Diana, 2014), the bedbug Scotinophara coarctata (Juliani & Yuliani, 2017), and the mealybug Aleurodicus dugesii (Widyastuti et al., 2018). However, the effectiveness of the extract is greatly influenced by the correct dosage to avoid toxicity or waste.

Research methods

This follow-up study used a Non-factorial Completely Randomized Design (RAK) by testing the stomach poison of kipahit leaf extract with several concentrations on the mortality rate of S. frugiperda larvae. This aims to determine the effect of stomach poison at an effective concentration to kill S. frugiperda larvae.

Testing for stomach poison with several concentrations symbolized (K) with the following levels:

K0 : Control
K1 : 0.1%
K2 : 0.2%
K3 : 0.3%
K4 : 0.4%
K5 : 0.5%

Preparation of test larvae was carried out on 10 S.frugiperda instar 3 larvae in each treatment, which were placed in a container with a diameter of 10 cm and a height of 7 cm. Soxhlet extract preparation is done by taking 50 g of kipahit leaf extract simplesia wrapped in filter paper that has been made into an elongated bag and then inserted into a round-bottom flask in a soxhlet. Soxhlet is carried out with 500 ml of acetone at a temperature of ≤700C until the droplet is no longer colorless (Anita and Lean 2016). Then evaporated until the solution reaches 50 ml. The application of stomach poison is carried out by testing the stomach poison by directly soaking the feed according to the concentration treatment for 10 seconds, then drying it on absorbent paper, then wrapping it with thin plastic and making a small hole for the entry of S. frugiperda larvae to eat the feed, then inserting the feed and S. frugiperda larvae into each treatment container.(Lisdayani, 2022). Feeding is done by giving young corn that has been cut into 1-2 cm pieces and given feed once a day with a feed weight of 50 g in each treatment container. The observation parameters in this study are as follows: Observation of the mortality rate, namely calculating the number of dead larvae, larvae are said to be dead if the larvae are touched and the larvae no longer move, which is observed in a time unit, namely once a day until all larvae die or become imago (Setiawan and Achmad, 2014).

$$M = \frac{b}{a + b} \times 100\%$$

Information :
M = Percentage of pest mortality
b = Number of dead S. frugiperda larvae
a = Number of live S. frugiperda larvae

LC50 (Lethal Concentration) is to determine the activity of the extract to kill 50% of S.frugiperda larvae and LT50 (Lethal Time) is the time required for the extract to achieve 50% death of S.frugiperda larvae.

Results and Discussion

Based on the data obtained, it shows that the stomach poison from the crude extract of T. diversifolia kipahit leaves has a significant effect on the mortality of S. frugiperda larvae.

Table 1. Influence DataStomach Poison of Kipahit T. diversifolia Leaf Extract on Mortality of S. frugiperda Larvae Observation 8 HSA.

Treatment	Stomach Poison
K0 (Control)	7.50 e
K1 (0.1%)	37.50 d
K2 (0.2%)	55.00 c
K3 (0.3%)	67.50 b
K4 (0.4%)	82.50 a
K5 (0.5%)	90.00 a

Information : In the same column, numbers followed by different letters indicate that they are significantly different from the Duncan 5% test.

In Table 1 it can be seen that the stomach poison test of crude extract of kipahit leavesT. diversifolia on the percentage of S. frugiperda larval mortality in 8 HSA observations. Shows that the highest mortality is at the concentration of K5 (0.5%) which is 90.00%, not significantly different at the concentration of K4 (0.4%) which is 82.50%, significantly different at the concentration of K3 (0.3%) which is 67.50%, significantly different at the concentration of K2 (0.2%) which is 55.00%, significantly different at the concentration of K1 (0.1%) which is 37.50%, and significantly different at the concentration of K0 (control) which is 7.50% which is the lowest mortality.

This is also thought to be due to the presence of compounds contained in kipahit leaf extract.T. diversifolia can disrupt the digestive system of S. frugiperda larvae so that S. frugiperda larvae cannot digest their food which causes S. frugiperda larvae to die of starvation. The same thing explained by Tri, et al., 2019 stated that alkaloid and flavonoid compounds enter the body of the larvae causing their digestive tract to be disrupted, the enzyme compound is also able to inhibit taste receptors in the mouth area of the larvae so that the larvae are unable to recognize their food. The effects of digestive toxins Mostly take place in the walls of the mesenteron (middle digestive tract) which is composed of epithelial cells. These active compounds will affect the digestive tract of the larvae by killing cells in the mesenteron so that energy formation is blocked so that nutrient absorption becomes less than optimal (Lisdayani, 2022). In addition, the higher the concentration given, the higher the mortality rate of S. frugiperda larvae.

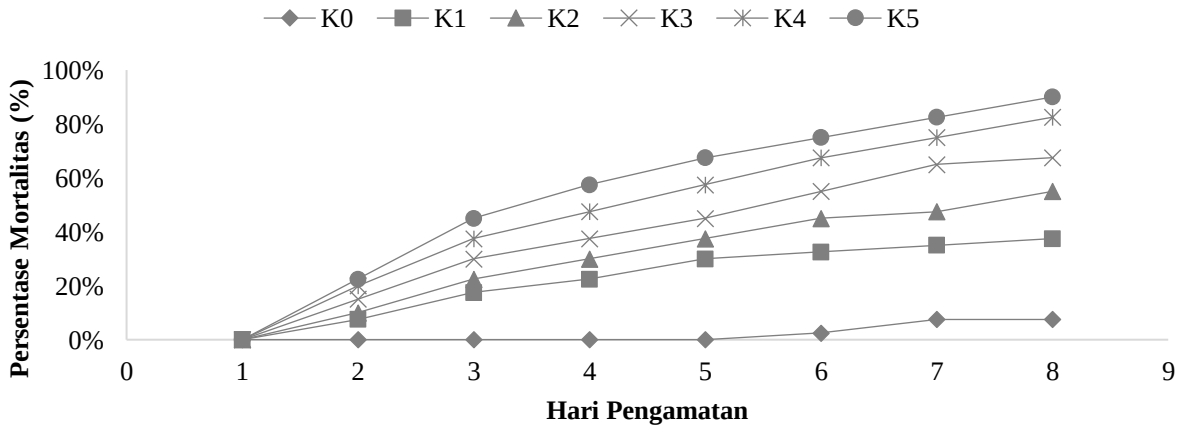

Figure 1. Mortality Graph of Stomach Poison Extract of Kipahit T. diversifolia Leaves on Mortality of S. frugiperda Larvae Observation 1-8 HSA

Based on Figure 1 above, it can be seen that mortality at 2-8 HSA of stomach poison testing of T. diversifolia kipahit leaf extract has an effect on the mortality of S. frugiperda larvae, showing that the highest mortality was at the K5 concentration (0.5%) reaching 23-90% at 2-8 HSA followed by the K4 concentration (0.4%) reaching 20-83% at 2-8 HSA, at the K3 concentration (0.3%) reaching 15-68% at 2-8 HSA, at the K2 concentration (0.2%) reaching 10-63% at 2-8 HSA, at the K1 concentration (0.1%) reaching 8-38% at 2-8 HSA, and the lowest percentage of larval mortality, namely the K0 concentration (control) had a mortality of 3-8% at 6-8 HSA. Meanwhile, based on the summary data of

LC50% data obtained from the effect of stomach poison from crude extract of T. diversifolia kipahit leaves on the mortality of S. frugiperda larvae 8 days after application (HSA), the probit data for stomach poison obtained were LC50%: 0.29, SK95%:0.08- 0.37, and Slope ± SE: 4.04 ± 1.54. On the stomach poison effect of T.diversifolia kipahit leaf extract on LC50%The lowest concentration of S. frugiperda larval mortality to reach LC50% was on the 8th day with a concentration of 0.29%. However, based on the summary data of LT50% data obtained from the effect of stomach poison extract of T. diversifolia kipahit leaves on the mortality of S. frugiperda larvae 8 days after application (HSA)

Table 2. Probit LT Data$_{50\%}$(Days) On the Effect of Contact Poison and Stomach Poison of Kipahit Leaf Extract of T. diversifolia on Mortality of S. frugiperda Larvae Observation 1-8 HAS

Treatment	Stomach Poison		
	LT50%	**SK 95%**	**Slope ± SE**
K1 (0.1%)	10.12 b	6.80 - 16.78	2.03 ± 0.52 a
K2 (0.2%)	6.85 a	4.84 - 9.05	2.46 ± 0.53 a
K3 (0.3%)	5.24 a	3.64 - 6.68	2.75 ± 0.51 a
K4 (0.4%)	4.14 a	2.93 - 5.20	3.13 ± 0.50 b
K5 (0.5%)	3.57 a	2.63 - 4.42	3.45 ± 0.48 b

In Table 2 it can be seen that in the treatment of stomach poison, kipahit leaf extractT.diversifolia on LT50% mortality of S. frugiperda larvae in observations of 1 - 8 HSA showed that the fastest LT50% was in the K5 (0.5%) treatment with LT50% of S. frugiperda larvae, namely 3.57 days

Conclusion

Extraction of the leaves of the T. diversifolia kipahit plant has a toxic stomach poison content that can affect the mortality of S. frugiperda larvae and the higher the concentration, the faster the mortality process of S. frugiperda larvae. The highest mortality was found at a concentration of K5 (0.5%) reaching 23-90% at 2-8 HSA.

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