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Effectiveness of Kipahit (*Tithonia diversifolia*) Leaf Extract on Pests, Diseases, and Green Spinach Plant Production

Efektifitas Ekstrak Daun Kipahit (Tithonia diversifolia) Terhadap Hama, Penyakit, dan Produksi Tanaman Bayam Hijau

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ABSTRAK

Pestisida Organik dari tanaman digunakan untuk mengurangi pencemaran dan kerusakan lingkungan yang ditimbulkan pestisida kimia. Salah satunya tanaman Kipahit yang dapat bekerja sebagai *antifeedant* dan *repellent* dengan senyawa aktif flavonoid. Penelitian ini bertujuan mengetahui efektifitas interval waktu pemberian ekstrak daun Kipahit pada organisme penggangu tanaman bayam hijau yang ditanam secara hidroponik dan dampaknya pada produksi tanaman. Penelitian dilaksanakan di Kebun Hidroponik Pamtasa Farm, Sawangan, Depok, Jawa Barat, dari November – Desember 2021. Penelitian menggunakan Rancangan Kelompok Lengkap Teracak (RKLT) dengan 6 perlakuan dengan masing-masing penyemprotan 500 ppm, yaitu; P0:Tanpa Penyemprotan (Kontrol), P1:Penyemprotan 2 hari sekali, P2:Penyemprotan 3 hari sekali, P3:Penyemprotan 4 hari sekali, P4:Penyemprotan 5 hari sekali, P5:Penyemprotan 6 hari sekali. Perlakuan diulang 4 kali sehingga didapat 24 unit percobaan, 8 tanaman per unit percobaan, sehingga terdapat 192 tanaman uji. Data dianalisis menggunakan Minitab versi 16 menggunakan parameter One Way Anova. Hasil penelitian menunjukkan penyemprotan ekstrak daun Kipahit setiap dua hari sekali dapat menekan penyakit Mosaik. Penyemprotan ekstrak daun Kipahit setiap lima hari sekali menunjukkan potensi menurunkan aktivitas larva *P. xylostella*. Persentase daun rusak terendah pada penyemprotan empat hari sekali yaitu sebesar 30.34%.

Kata kunci: Flavonoid, *Plutella xylostella*, Mosaik daun.

ABSTRACT

Organic pesticides from plants as Kipahit plant can work as an antifeedant and repellent with active flavonoid compounds. This research aims to determine effectiveness of time interval for administering Kipahit leaf extract on pest on green spinach plants grown hydroponically and its impact on plant production. The research was carried out at Pamtasa Farm Hydroponic Garden, Sawangan, Depok, West Java, from November – December 2021. The research used a Randomized Complete Group Design with 6 treatments with each spraying 500 ppm, namely; P0: No Spraying (Control), P1: Spraying once every 2 days, P2: Spraying once every 3 days, P3: Spraying once every 4 days, P4: Spraying once every 5 days, P5: Spraying once every 6 days. The treatment was repeated 4 times to obtain 24 experimental units, each unit consists of 8 plants, so there were 192 test plants. Data were analyzed using Minitab version 16 using One Way Anova parameters. The research results show that spraying Kipahit leaf extract once every two days can suppress mosaic disease. Spraying Kipahit leaf extract once every five days shows the potential to reduce the activity of P. xylostella larvae. The lowest percentage of damaged leaves was sprayed once every four days, namely 30.34%.

Keywords: *: Flavonoids, Plutella xylostella, Cucumber Mosaic Virus.*

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INTRODUCTION

National food availability is influenced by many factors, including the level of productivity of food crops. The effectiveness of pest control also plays a role. The presence of pests and plant diseases in agricultural crop cultivation areas threatens the stability of crop production and productivity, and causes real yield losses (Agustini *et al.*, 2023). The main problem often faced in organic farming activities is the presence of Plant Pest Organisms (PPO), especially in tropical areas because tropical climate conditions will greatly support the development of PPO. Therefore, intensive pest control is needed, including using pesticides. The use of synthetic chemical pesticides is prohibited in organic farming systems so the use of organic pesticides is very strategic.

In general, organic pesticides are defined as pesticides made from natural ingredients. Organic pesticides are relatively easy to make with simple materials and technology, natural raw materials make organic pesticides easily decomposed (biodegradable) in nature so they do not pollute the environment (Theresia, *et al.*, 2023). Several research results show that the Kipahit plant can be used as an organic pesticide as an antifeedant and repellent because it contains flavonoids, alkaloids and tannin compounds. Flavonoid compounds in kipahit leaf filtrate can inhibit the growth of bacteria (Wahyuni *et al*., 2021), nematodes (Yansyah *et al.*, 2023), these compounds can also inhibit the ability of pests to eat (Sapoetro *et al*., 2019; Hartini *et al.*, 2022).

Plants cultivated hydroponically in a greenhouse have the advantages, namely; water planting media so that plants are cleaner, nutrition is controlled, agroclimate is controlled, and the use of shade minimizes pest attacks. The productivity and quality of spinach plants has been proven to increase with the use of a hydroponic system in the greenhouse (Dewi, 2020). However, greenhouse technology in tropical areas functions to protect plants from direct rain and excessive light intensity so that greenhouse construction is simpler. This condition causes the need for environmental control, especially pest control. To maintain the quality and safety of vegetables, it is necessary to pay attention to the choice of using organic pesticides.

Based on this description, the Kipahit plant is one of the plants whose existence can be used to make environmentally friendly organic pesticides. Considering the potential importance of Kipahit, it is necessary to carry out research to obtain information on how to apply Kipahit to spinach plants at different application time intervals against pest attacks and its impact on spinach crop production.

METHODS

This research was carried out on 20 November – 21 December 2021 at the Pamtasa Farm Hydroponic Garden, Sawangan, Depok, West Java. The research location is at an altitude of ±55 meters above sea level (masl). Tools used in making organic pesticides include; measuring cup, container, knife, filter, and TDS meter.

The ingredients used in making organic pesticides are Kipahit leaves and water. Plant cultivation uses a hydroponic installation with a Nutrient Film Technique (NFT) system with 200 planting holes, TDS meter, analytical scales, sprayer, tray and netpot. The materials used in cultivating spinach plants are AB Mix (Calcinit, KNO3, BMX, MKP, MagS), water, green spinach seeds of the Amarin® variety, and rockwool.

The experimental design used was a Randomized Complete Group Design (RCGD) consisting of six treatments with a pesticide spray concentration of 500 ppm in each treatment. The six treatments consist of; P0 (No Spraying), P1 (Spraying twice a day), P2 (Spraying once every 3 days), P3 (Spraying once every 4 days), P4 (Spraying once every 5 days) (Kholidi, 2016), P5 (Spraying once every 6 days). Each treatment was repeated four times so that there were 24 experimental units, each experimental unit consisted of 8 plants, so the total number of plants observed was 192 plants. The data obtained were analyzed using Minitab software version 16 using One Way Anova parameters with a Tukey or BNJ follow-up test with an error rate of 5%.

Kipahit Leaf Extract Organic Pesticide

Kipahit leaf extract pesticide is made by grinding 1 kg of Kipahit leaves and then mixing it with 3 liters of air. The mixture heated over low heat for 30 minutes then the decoction of Kipahit leaves is filtered. The filtered water will be used as a pesticide test. The process of making pesticides does not use adhesives because this research only tested kipahit leaves as a pesticide without using other additional ingredients.

Organic Pesticide Application

Pesticide application is carried out after transplanting from the nursery to the hydroponic installation at the age of 2 – 4 weeks after planting (WAP), using Kipahit leaf extract which has been made into pesticide and then sprayed using a sprayer according to the treatment with a pesticide concentration of 500 ppm with a spraying volume of 600 ml on rejuvenation phase and 900 ml in the maturation phase in each treatment. Pesticides are made once for all applications. Spraying on the leaf stems of plants. Spraying on plants aged 2, 3, and 4 WAP

Identify the invading pest

Observations are carried out between planting and harvesting by observing and analyzing the type of pest, target of attack, damage caused, attack score, and pest dominance.

Identify disease attacks

Observations are made at the time of transplanting until harvesting by observing the symptoms of disease on the plants and the type of disease that attacks them.

Percentage of damaged leaves (%)

The calculation is carried out at the time of harvest by counting the population of leaves that have holes or are damaged and then calculated using the formula according to Kholidi (2016).

$$P = \frac{\Sigma(n \times v)}{Z \times N} \; x\ 100\%$$

Information :
p : Plant damage (%)
v : Attack scale value

n : Number of plants that have the same v value
Z : Highest attack category value (v = 4)
N : Number of plants observed

Determining the attack score value is as follows:

0=No attack
1=damage less than or equal to 25%
2=damage greater than 25% and less than or equal to 50%
3=damage greater than 50% and less than or equal to 75%
4=damage greater than 75%

Production

Gross weight and consumption weight are measured at harvest.

RESULTS AND DISCUSSION

General Condition

This research was conducted from November 2021 to December 2021. Based on climate data obtained from Badan Meteorologi Klimatologi dan Geofisika (BMKG), (2021), it shows that the climate in November 2021 had an average temperature of 27.74 ºC, humidity 81.60 %, rainfall 696.82 mm/month, and sunlight intensity 4.06 hours. In December 2021 the average temperature is 27.46 ºC, humidity 84.40%, rainfall 999.74 mm/month, sunlight intensity 3.81 hours. During the research, environmental conditions were still in accordance with the requirements for growing spinach plants, namely according to Herpiandi (2019) stated that spinach plants require a lot of sunlight, with an optimal temperature ranging between 20-30 ºC, rainfall between 1000 – 2000 mm, and with regional humidity of 60 %.

Identify pests

Identification of pest types is carried out with the aim of finding dewiout the types of pests that attack spinach plants. Pest identification is carried out every day from the rejuvenation phase to harvest. *Plutella xylostella* larvae and grasshoppers attack plants from 2 WAP to 4 WAP.

Table 1. Pest types, targets, and pest attack score

Species	Attacks	
	Targets	Scores
Larvae of Diamondback Moth (*Plutella xylostella*)	leaf	2
Grasshopper (*Oxya chinensis*)	leaf	2
Cashew Planthopper (*Sanurus indecora*)	stem	0

Table 1 shows that spinach plants were attacked by *P. xylostella* larvae from the order Lepidoptera, and grasshoppers (*O. chinensis*) from the order Orthoptera which caused damage such as leaves becoming hollow due to pest bites, making them unfit for

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consumption. This condition can also be seen from the high attack score of 25% to 50% of the damage caused. *S. indecora* from the order Hemiptera was found several times on the stems of spinach plants, but no visible damage was caused by the pest. Based on Table 1, there are two types of insects that dominate attacks on leaf organs, namely *P. xylostella* larvae and grasshoppers. The results of the research show that *P. xylostella* larvae are the main pest in spinach cultivation in greenhouses. This condition is indicated by the presence of *P. xylostella* larvae in all treatments in greater numbers compared to grasshoppers. The presence of pests and diseases in plants cultivated hydroponically in greenhouses is generally due to a lack of equipment sterilization and greenhouse sanitation (Antika, 2023). The application of chemical pesticides in greenhouses increases the risk of pesticide poisoning with symptoms ranging from moderate to severe in greenhouse farmers (Oktaviani & Pawenang, 2020). Therefore, the use of botanical pesticides can be a safe choice for farmers.

Based on Figure 1, the plants that were treated with the organic pesticide Kipahit extract in all treatments were apparently attacked by *P. xylostella* larvae. 70.84% of plants were attacked by *P. xylostella* larvae from the total plant population. Grasshoppers were found in all treatments with an average of 14.41% of the spinach plant population being attacked. The presence of cashew leafhopper was indeed found but there were no visible signs of plant damage due.

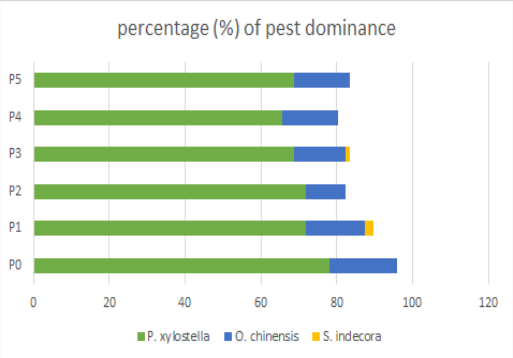


Figure 1. percentage of pest dominance.

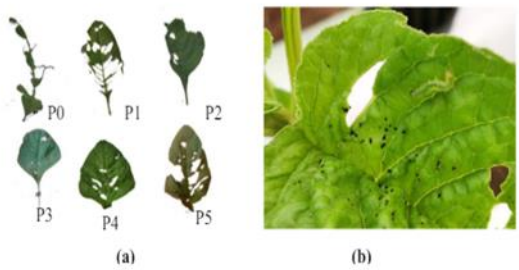


Figure 2. (a) attack of larvae, (b) *P. xylostella.*

The larvae of *P. xylostella* really has an impact on the physical appearance of the plant, especially the leaves. Larvae attack plants by biting and eating them, apart from eating parts of the leaves. Symptoms of attack caused by this larvae can be mild to severe. Some attacks only make holes in several parts, causing heavy damage leaving only the stems, the leaves become unfit for consumption (Figure 2a). This larvae also excretes a lot of black feces on the surface of the leaves (Figure 2b). According to Gazali & Ilhamiyah (2022), larvae are a stage in the metamorphosis of insects entering the feeding phase which generally damages plants because they eat the leaves or stems of plants, thus becoming the main pest of horticultural crops. On plant leaves, the larvae will damage the leaves by biting, chewing and then eating the lower surface of the leaves, the leaves will be transparent white and the leaf veins will remain. Leaves with this condition cause a decrease in plant production and even kill the plant.

O. chinensis have an influence on the physical appearance of plants, especially on the leaves. The grasshopper attacks plants by biting and eating them starting from the edge of the leaf to the center of the leaf. This is in accordance with the opinion of

Dewantara *et al*., (2020) which states that grasshoppers eat plant leaves from the edge of the leaf to the middle of the leaf, thereby reducing the surface area of the leaf which causes the leaf to become hollow. *S. indecora* was found on spinach plants in the rejuvenation and maturity phases. This insect was found several times perched on the stems of spinach plants, but no signs of damage were found.

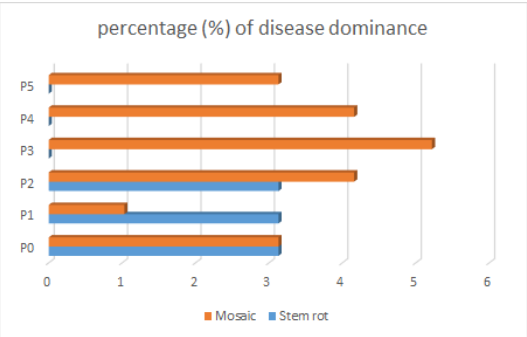
Identification of Disease Attacks

Disease identification is carried out with the aim of finding out the type of disease that attacks spinach plants and the attack symptoms caused by this disease. The following are diseases that have been identified as having attacked spinach plants (Table 2).

Table 2. Types of diseases that attack spinach plants

Disease	Affected part	Cause	Source
Stem rot	stem	*Fusarium* sp.	Istikorini & Sari (2020)
Mosaic	leaf	Cucumber Mosaic Virus (CMV)	Nasution *et al*., (2023)

Based on Table 2, the types of disease that attack include stem rot disease caused by the fungus *Fusarium* sp. and mosaic disease caused by Cucumber Mosaic Virus (CMV). Both cause damage to plant leaves. Stem rot disease was detected at 2 WAP, while mosaics on the leaves appeared at 3 WAP.



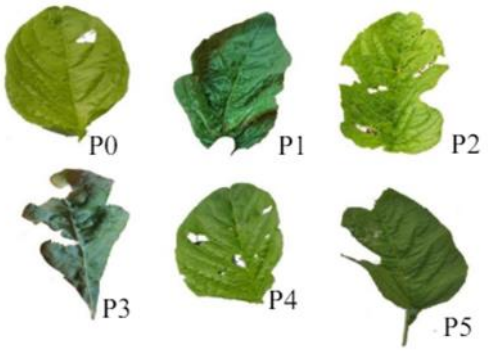


Figure 3. percentage of disease dominance. **Figure 4**. leaves attacked by mosaic.

Based on Figure 3, mosaic disease attacks plants in all treatments, while stem rot disease is only found in P0, P1, and P2. Stem rot disease attacks spinach plants on the stems, the symptoms are brown at the bottom of the stems which starts out small and then becomes more numerous, causing wilting and even causing the spinach plant to die. This is in accordance with the opinion of Tejawati *et al*., (2023) who stated that the symptoms of stem rot disease show symptoms on the stem such as; the base of the stem changes color, the roots are rotting, the base of the stem is brown. This condition ultimately causes the stem to rot and is no longer able to support the stem and crown of the plant. Stem rot disease in spinach plants more often attacks plants in the rejuvenation phase when the plants are 2-4 WAP. According to Istikorini & Sari (2020),

stem rot can be caused by *Fusarium* sp. which can attack plants starting from seedlings causing young plants to fall.

Mosaic disease attacks spinach plants on the leaves, the symptoms caused are that the leaves become conical or shriveled and do not look like perfect leaves (Figure 4). This is in accordance with the opinion of Marianah (2020) stated that plants infected with the virus show symptoms such as stunted plants, yellowing leaves, smaller leaf size, disturbed growth of shoots and buds, curly leaf tips and chlorosis. Nasution *et al*., (2023) reported that leaves infected with the CMV virus showed changes in the leaves such as spots on the leaf blades, heavy infections caused chlorosis.

Percentage of Damaged Leaves

The percentage of damaged leaves was measured to determine the effect of the interval of spraying Kipahit leaf extract on damage to the leaves of green spinach plants. The results of the analysis of variance carried out showed that Kipahit leaf extract spraying treatment did not have a significant effect on the percentage of damaged leaves of green spinach plants. Table 3 shows that applying organic pesticides at various time intervals showed no effect on the percentage of damaged leaves. The damage observed was classified as moderate for all treatments, namely in the range of 30-55%.

Table 3. Percentage of damage leaves and production

Treatments	Percentage damage leaf (%)	Gross weight (g)	Consumption weight (g)
No spraying	45.31 a	53.37 ab	30.97 abc
Spraying twice a days	55.99 a	46.48 b	25.85 c
Spraying once every 3 days	46.09 a	60.91 a	35.78 ab
Spraying once every 4 days	30.34 a	57.66 a	28.44 bc
Spraying once every 5 days	48.44 a	61.93 a	37.70 a
Spraying once every 6 days	45.31 a	59.21 a	32.40 abc

Note: Numbers followed by the same letter in the same column are not significantly different based on the 5% level BNJ test (duncan)

Based on Table 3, the Kipahit leaf extract has not been able to completely reduce leaf damage caused by insect. This is because there is no adhesive in the pesticide formulation so that the pesticide does not stick perfectly to the surface of the leaves. This condition make pesticide that has been sprayed fades more quickly. This is in accordance with the opinion of Manik *et al*., (2020) that applying adhesive to organic pesticides aims to make organic pesticides last longer and stick to plants so that the pesticides are more resistant to weather changes, especially leaching by rainwater and dew. This condition is reinforced by the opinion of Kholidi (2016) who states that organic pesticides that are imperfectly applied to plants will result in many pest attacks on cultivated plants.

Production

Based on table 3, there was an increase in the gross weight of spinach plants with the administration of Kipahit leaf extract. Gross weight is the total weight of the plant at harvest. Plant consumption weight varied with the highest consumption weight in the

treatment spraying once every five days but not significantly different from spraying once every three days, once every six days and the control. Thus, giving Kipahit leaf extract is thought to be able to maintain greater consumption weight related to the presence of pests and diseases of spinach plants. According to (Rahayu *et al.*, 2020), the wet weight of spinach will be high if the spinach has fresh stems, leaves that don't fall off, and leaves that do not have holes. Apart from that, the number of pest attacks affects the gross weight of the plant because the more pests that damage the leaves, the photosynthesis process will be hampered due to the damage to the leaves.

CONCLUSION

The effect of the time interval for spraying the organic pesticide Kipahit leaf extract has not been able to overcome pest and disease attacks on spinach plants, especially *P. xylostella* larvae. However, spraying Kipahit leaf extract every two days can suppress mosaic disease. Spraying Kipahit leaf extract once every five days shows the potential to reduce the activity of *P. xylostella* larvae. . The lowest percentage of damaged leaves was sprayed once every four days, namely 30.34%. Further research suggests using adhesives in organic pesticides so that they stick to plant leaves longer.

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