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Effectiveness of Insecticide–Surfactant Combinations Against Thrips palmi on Eggplant

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ABSTRACT

Eggplant (Solanum melongena L.) is an important horticultural crop in Indonesia; however, its productivity is frequently constrained by thrips infestation (Thrips palmi). This study aimed to evaluate the effectiveness of combinations of insecticide active ingredients and Ronstick surfactant in reducing the intensity of T. palmi attacks on eggplant plants. The research was conducted in Ender Village, Pangenan District, Cirebon Regency, from May to August 2025 using a Randomized Block Design with seven treatments and three replications. Treatments consisted of abamectin, dinotefuran, and their combinations, each applied with Ronstick surfactant at concentrations of 1–2 ml/L, and a control without insecticide. The results showed that insecticide–surfactant combinations significantly reduced thrips population and attack intensity compared to the control. The combination of abamectin + dinotefuran with surfactant at 2 ml/L was the most effective treatment. These findings indicate that appropriate insecticide–surfactant combinations can enhance thrips control efficiency while supporting more rational insecticide use.

Keywords: Eggplant, Insecticide, Thrips

1.INTRODUCTION

Eggplant (Solanum melongena L.) is an important horticultural crop in Indonesia. Eggplant is highly nutritious, particularly due to its high vitamin A and phosphorus content (Muldiana & Rosdiana, 2017). 90% of global eggplant (Solanum melongena L.) production is in Asia. Indonesian eggplant production reached 699,896 tons in 2023 and declined to 675,397 tons in 2024.(BPS, 2025). Many factors can inhibit eggplant productivity, but one of the factors causing decreased eggplant productivity is pest attacks.Pests are organisms that damage plants and have the ability to control plant populations and reduce the quality and quantity of cultivated crops. Generally, pests consist of insects and several other animals that damage plants (Herlina, 2021) in (Bahri, 2024). One of the important pests of eggplant plants (*Solanum melongena L.*) is Thrips (*Thrips palmi*) (Haerul et al., (2015).

Eggplant cultivation in Asia still relies on seasonal pesticide spraying. However, the continued use of synthetic pesticides can lead to pest resistance and environmental pollution

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(Srinivasan, 2009). However, farmers in the field still rely on synthetic insecticides to prevent damage from pest attacks, so the use of pesticides by farmers cannot be stopped and simply abandoned.

Insecticides with active ingredients frequently used to control Thrips palmi are abamectin and dinotefuran. Abamectin acts as a contact and stomach poison, causing paralysis and ultimately death in the insect (Kuhar et al., 2022). Meanwhile, dinotefuran is a contact poison, which works by disrupting the nervous system, causing excessive stimulation of receptors and resulting in systemic toxicity (Gálvez et al., 2018).

Research on abamectin application to various plant species shows that effective doses vary widely, ranging from 0.25 ml/L to 2.5 ml/L, depending on the crop. Furthermore, the most effective application frequency is generally once a week at a dose of approximately 1 ml/L (Arfan et al., 2019). Insecticide application is carried out by spraying according to the treatment formulation (Deden et. Al., 2023).

To address this problem without excessively increasing insecticide dosages, innovation is needed by adding ingredients that can increase insecticide effectiveness. One potential additive is surfactants. Surfactants can increase insecticide penetration into pests and act as adhesives to make the insecticide last longer on both plants and pests.

Ronstick surfactant, as a non-ionic surfactant, works by reducing the surface tension of the spray solution so that the solution can spread more evenly and stick longer to the surface of the leaves and the body of the pest (Gerry et al., 2023). With these properties, surfactants can act as wetting agents, emulsifiers, adhesives and solvents which increase the effectiveness of pesticides (Ansel, 1989) in (Wahyuni et.al., 2014).

2. RESEARCH METHOD

This research was conducted in Ender Village, Pangenan District, Cirebon Regency, with an altitude of ±5 meters above sea level with an average temperature of 23°C to 31°C. This research was conducted in May - August 2025. The method used in this research was a Randomized Block Design (RAK), the research consisted of 6 treatments with two active insecticide ingredients and a control (without insecticide) repeated 3 times so that there were 21 experimental plots. Observations consisted of seven treatment levels as follows:

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A : Control (without insecticide application)
B : Abamectin 1 ml/l + Surfactant 1 ml/l
C : Abamectin 2 ml/l + Surfactant 2 ml/l
D : Dinotefuran 1 ml/l + Surfactant 1 ml/l
E : Dinotefuran 2 ml/l + Surfactant 2 ml/l
F : Concentration Abamectin + Dinotefuran (1 ml) + Surfactant 1 ml/l
G : Concentration Abamectin + Dinotefuran (2 ml) + Surfactant 2 ml/l

Thrips population observation is a calculation of the average population density of thrips pests with samples from the total plants and on plant leaves in each bed and in each experimental plot. Observation of the thrips pest population is carried out by counting all thrips pests directly on each part of the plant (leaves and flowers). Observation of the thrips pest population was carried out at 12, 14, 21, 28, 35, 42, 39 and 56 DAP of insecticide active ingredients treatment with a combination and surfactant during the research period. The number of thrips individuals collected was counted, then the average population was calculated using the formula:

$$Average\ population = \frac{Jumber\ of\ thrips\ nymphs\ or\ imagoes\ found}{number\ of\ plants\ observed}$$

Inspection of Thrips palmi attack intensity was carried out by observing the symptoms of pest attacks on the leaves, including changes in leaf color to copper-brown spots, curled, wrinkled, and rolled leaves. Observations were carried out starting from the age of 14 days after planting. Observations were carried out three times in the morning. The percentage of plants or plant parts showing signs of pest attack was calculated using the following formula:

$$IS = \frac{a}{a+b} x\ 100\%$$

Based on this formula, IS is the intensity of the attack, a is the number of plants attacked, and b is the number of plants that are not attacked.

Observation of damage intensity is calculated based on the level of damage. The scale value of the damage category is based on the symptom criteria from (0-5) with,

0 = normal, no color change/not curled (healthy leaves),

1 = color change (light yellow or small spots), some leaves are wrinkled/curled, but the leaves have not yet curled (light attack > 0-25%),

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2 = leaf color change is more obvious (silvery yellow or brown spots), some leaves are wrinkled/curled, but the edges are starting to curl slightly (significant attack > 20-40%),

3 = leaves have changed color more extensively (dark yellow/brown), many leaves are wrinkled and some leaves are moderately curled (moderate attack > 40-50%),

4 = almost all leaves have changed color, the leaves are very curled/wrinkled, and most of the leaves are curled severely, so that growth is disrupted and the plant becomes stunted (moderate attack > 50-75%),

5 = all leaves have changed color, so that the leaves are severely curled and curled completely, so that many leaves fall/die, so that the plant becomes stunted and eventually dies (severe attack > 75-100%).

According to the formula, the intensity of damage due to pest attacks is calculated using the Natawigena (1993) formula as follows:

$$IK = \frac{\Sigma\,(n\ x\ v)}{N\ x\ Z} \text{x } 100\%$$

Based on this formula, I represents the Intensity of Damage, n is the number of plants observed from the attack category, v is the scale value of the attack category, N is the total number of plants observed and Z is the scale value of the highest attack category (0-5).

Observations were made starting from when the plants were 14 days after planting. Observations were made three times in the morning.

Measuring the success of treatment in suppressing the Thrips population compared to the control without treatment is calculated using the Abbott (1981) formula:

$$\text{EI} = \frac{(C\alpha - T\alpha)}{C\alpha} \text{ x } 100\%$$

Based on this formula, EI represents Insecticide Effectiveness (%), Cα is the thrips population in the control treatment plot after application and Tα is the thrips population in the treatment plot after application.

The EI value indicates the percentage reduction in pest population or attack intensity due to insecticide treatment compared to the control. Insecticide application intensity is considered effective if the EI value reaches at least 50% in most observations.

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The observation data will be processed using a variance analysis test using Randomized Block Design Analysis (RAK), the analysis is used to determine the effect of the interaction of the treatments being tested, with a linear model according to Wijaya (2023), as follows:

$$Y_{ij} = \mu + A_i + B_j + \varepsilon_{ij}$$

Based on the table, Y_{ij} represents the response to the first repetition, μ is the general average, Ai = Effect of the first repetition, B_j is the effect of the jth treatment and ε_{ij} is the effect of the experimental error.

Further testing is carried out if the data is significant in the analysis of variance, then it will be continued with the DMRT (Duncan Multiple Range Test) at the 5% level. The Duncan multiple range test formula according to Wijaya (2023) is as follows:

$$\text{LSR Test : LSR} = SSR_{0,05} \times \sqrt{\frac{KTG}{r}}$$

Based on this formula, LSR represents the Least Significant Range, SSRp is the Value from the New Multiple Range Test Table, KTG is the Middle Square Error and R = Repetition.

3. RESULTS AND DISCUSSION

Supporting Observations

Number of Leaves

The analysis results showed that the combination of insecticide active ingredients and surfactants significantly interacted with the average number of leaves at 21 and 49 days after planting. The detailed analysis results can be seen in Table 1.

Table 1. Effect of Insecticide Active Ingredients Treatment with Surfactant Combination on the Number of Eggplant Leaves at 7, 21, and 49 Days After Planting (Sheets)

Treatment	Average Number of Leaves (Sheets)		
	7 DAP	21 DAP	49 DAP
A	2.83	5.89	8.33
B	3.19	5.92	9.83
C	3.17	5.83	9.39
D	3.11	6.03	10.5
E	3.11	5.61	9.53
F	3.47	6.42	9.39
G	3.33	6.14	9.50

Description: Different average figures in the columns indicate significant differences.

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Table 1 above shows that the combination of surfactant and insecticide active ingredients significantly affected the average number of leaves at 7, 21, and 49 days after planting. This is thought to be due to the fact that at 7 days after planting, the plants already have a relatively large number of leaves when transplanted, and the roots are not damaged, allowing them to adapt quickly to the environment and encouraging leaf growth.

Eggplant Yield Weight (Kg)

The analysis results showed that the combination of insecticide active ingredients and surfactants significantly affected the average fruit weight per plant. Details of the analysis are shown in Table 2.

Table 2. Effect of Insecticide Active Ingredients Treatment with Surfactant Combination on Eggplant Yield Weight.

Treatment	Fruit Weight per Plant (Kg)				
	21 DAP	35 DAP	42 DAP	49 DAP	Average
A	0.37	0.49	0.73	0.31	0.47
B	1.12	0.43	0.74	0.24	0.63
C	0.93	0.61	0.69	0.24	0.62
D	1.10	0.35	0.93	0.82	0.80
E	0.84	0.42	0.18	1.24	0.67
F	0.58	0.35	1.50	0.61	0.76
G	0.37	0.70	0.24	0.55	0.46

Description: Different average figures in the columns indicate a significant difference.

Plant Height

The analysis results showed that the combination of insecticide active ingredients and surfactants significantly affected average plant height. Details of the analysis are shown in Table 3.

Table 3. Effect of Insecticide Active Ingredients Treatment with Surfactant Combination on Eggplant Plant Height at 7, 21, and 49 Days After Planting (cm)

Treatment	Average Plant Height (cm)		
	7 HDAP	21 DAP	49 DAP
A	7.22	14.45	26.69
B	10.56	21.52	45.31
C	11.75	22.80	44.47
D	10.70	22.01	46.27
E	10.27	21.57	45.33
F	10.45	21.83	44.63
G	11.11	22.74	40.78

Description: Different average figures in the columns indicate significant differences.

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Thrips Lifestyle

After conducting observations, thrips are the most dangerous pest for eggplant plants. These pests attack eggplant leaves, especially the tips, which can cause curling of the affected leaves. Thrips can disrupt eggplant growth and even lead to crop failure. Thrips are often found living on the top three leaves of eggplant plants.

Main Observations

Thrips Population

In this study, the thrips population was determined by directly counting all thrips on each plant part (leaves and flowers). Thrips population observations were conducted at 12, 14, 21, 28, 35, 42, 49, and 56 days after planting (DAP) for the insecticide active ingredient combination and surfactant treatments during the study period.

Table 4. Average thrips population

Treatment	Average Thrips Pest Population							
	12DAP	14DAP	21DAP	28DAP	35DAP	42DAP	49DAP	56DAP
A	5.30	11.02	8.52	6.16	10.52	8.72	5.72	6.50
B	7.50	6.61	2.94	2.36	3.44	3.11	3.05	3.88
C	6.33	4.16	4.61	2.75	1.91	1.25	2.27	3.19
D	6.75	5.88	4.47	2.94	1.13	1.05	2.00	3.50
E	7.41	5.33	2.97	0.55	0.97	0.69	1.30	2.77
F	5.30	4.16	2.13	0.94	1.36	1.25	2.02	3.19
G	6.63	6.41	3.80	0.52	1.33	1.50	1.69	2.61

Source: Primary Data 2025

Table 4 above provides information regarding the average thrips pest population. The lowest thrips pest population was at 28 DAP with a value of 0.52% with the treatment of Abamectin + Dinotefuran (2 ml) + Surfactant 2 ml/1 concentration and the highest thrips pest population was at 14 DAP with a value of 11.02% with the Control treatment (without insecticide application).

Observations and Calculations of Thrip Pest Infections

Intensity of Infestation and Damage

Based on the data in the table below, the average intensity of attack for the insecticide treatments was significantly different compared to the control.

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Table 5. Effectiveness of various active insecticide ingredients on the intensity of thrips pest attacks on eggplant plants aged 3, 5 and 7 WAP (%)

Insecticide Treatment	Average intensity of pest attacks (%)		
	3 WAP	5 WAP	7 WAP
Control	89.70	87.98	85.66
Abamectin 1 ml + Surfactant 1 ml/1	75.66	76.01	77.00
Abamectin 2 ml + Surfactant 2 ml/1	67.44	69.18	59.89
Dinotefuran 1 ml + Surfactant 1 ml/1	57.98	57.22	62.85
Dinotefuran 2 ml + Surfactant 2 ml/1	58.44	55.63	56.77
Abamectin + Dinotefuran (1 ml) + Surfactant 1 ml/1	57.50	55.51	56.33
Abamectin + Dinotefuran (2 ml) + Surfactant 2 ml/1	41.68	49.03	46.96

Source: Primary Data 2025

Table 5 above provides information related to the average decrease in the intensity of Thrips pest attacks. In the observation of the 3rd (three) week to the 7th (seventh) week. The Abamectin + Dinotefuran (2 ml) + Surfactant 2 ml / l) Concentration Treatment showed the lowest data after application compared to other types of surfactants. The average decrease in the incidence of attacks on eggplant plants, in the control treatment (A) decreased from 89.70% to 85.66%, while in the treatment of Abamectin 1 ml / l + Surfactant 1 ml / l (B) can suppress Thrips pest attacks down to 77.00%, then in the treatment of Abamectin 2 ml / l + Surfactant 2 ml / l (C) can suppress Thrips pest attacks down to 59.89%, Furthermore, the treatment of Dinotefuran 1 ml/1 + Surfactant 1 ml/1 (D) can suppress Thrips pest attacks down to 62.85%, then the treatment of Dinotefuran 2 ml/1 + Surfactant 2 ml/1 (E) can suppress Thrips pest attacks down to 56.77%, then the treatment of Abamectin + Dinotefuran (1 ml) + Surfactant 1 ml/1 (F) can suppress Thrips pest attacks down to 56.33% and finally the treatment of Abamectin + Dinotefuran (2 ml) + Surfactant 2 ml/1 (G) can suppress Thrips pest attacks down to 46.96%. These results show that the application of insecticides with various types of surfactants is able to reduce Thrips pest attacks as indicated by the incidence, this was also conveyed by Mujiono (2018) that control with insecticides showed an effect on pest attacks as indicated by a decrease in incidence from 56.26% to 0%.

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Insecticide Effectiveness

The effectiveness of each surfactant in the application of Tenchu 20 SG insecticide with several types of surfactants can be seen from the resulting reduction in pest attack rates. The reduction in incidence is shown in Table 6, the results of the Randomized Block Design (RBD) analysis are shown in Table 7, and the Duncan Multiple Range Test (DMRT) for Thrips attacks is shown in Table 8.

Table 6. Percentage Reduction in Thrips Incidence

Treatment	Incidence Before Application (%)	Incidence After Application (%)	Decrease (%)
Kontrol	100	85.66	14.34
Abamectin+Surfactant 1ml	100	77.00	23.00
Abamectin+Surfactant 2ml	100	59.89	40.11
Dinotefuran+Surfactant 1ml	100	62.85	37.15
Dinotefuran+Surfactant 2ml	100	56.77	43.23
Abamectin+Dinotefuran+Surfactant 1ml	100	56.33	43.67
Abamectin+Dinotefuran+Surfactant 2ml	100	46.96	53.04

Source: Primary Data 2025

The table above shows the percentage of decrease in the incidence of Thrips pest attacks. Observations made until the 7th week showed that the control treatment experienced a decrease in Thrips pest attacks, while the Abamectin + Surfactant (1ml) treatment experienced a decrease in Thrips pest attacks by 23.00%, the Abamectin + Surfactant (2ml) treatment experienced a decrease in Thrips pest attacks by 40.11%, the Dinotefuran + Surfactant (1ml) treatment experienced a decrease in Thrips pest attacks by 37.15%, the Dinotefuran + Surfactant (2ml) treatment experienced a decrease in Thrips pest attacks by 43.23%, the Abamectin + Dinotefuran + Surfactant (1ml) treatment experienced a decrease in Thrips pest attacks by 43.67% and finally the Abamectin + Dinotefuran + Surfactant (2ml) treatment experienced a decrease in Thrips palmi pest attacks by 53.04%.

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Table 7. Results of ANOVA Analysis of Thrips Pest Incidence

Sk	Db	Jk	Kt	F Count	F Table		Ket.
					5%	1%	
Group	2	2.67	1.33	0.16	3.89	6.93	tn
Treatment	6	3589.90	598.32	72.77	3.00	3.87	**
Error	12	98.67	8.22				
Total	20	3691.24					

Note **: Very significantly different at the 5% test level

Table 8. Results of BNT Advanced Test on the Incidence of Thrips Pest Attacks

Treatment	Average	Value LSD 5%
A	88.00e	
B	76.33d	1.66
C	74.33d	
D	65.33c	
E	59.33b	
F	56.33ab	
G	46.00a	

Note: Average numbers followed by the same letter are not significantly different at the 0.05 test level.

Calculation of the reduction in the incidence of Thrips pest attacks was carried out using a BNT advanced test to show the effectiveness of various types of surfactants in overcoming Thrips pest attacks. Based on the results and incidence analysis that had been carried out using the BNT advanced test, it was found that the insecticide treatment was very significantly different from the control treatment, Abamectin + surfactant (1ml) treatment, Abamectin + surfactant (2ml) treatment, Dinotefuran + surfactant (1ml), Dinotefuran + surfactant (2ml), Abamectin + Dinotefuran + surfactant 1ml treatment and Abamectin + Dinotefuran + surfactant (2ml). Based on the incidence data that had been carried out using the BNT advanced test, it could be concluded that the Abamectin + Dinotefuran + surfactant (2ml) treatment was the most effective treatment in overcoming Thrips pest attacks.

Based on the results of the analysis, it shows that several types of insecticides have a very significant effect at the 5% test level on the percentage of reducing the incidence of Thrips pest attacks. The presumptive cause of the very significant effect on the percentage of reducing the incidence of Thrips pest attacks is thought to be due to differences in viscosity and adhesive power

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in various types of insecticides. Based on the research data that has been obtained, the type of insecticide concentration of abamectin + dinotefuran + surfactant (2ml) has a tendency to reduce the incidence of Thrips pest attacks that are higher compared to other types of insecticides. This is because the combination of abamectin + dinotefuran + surfactant contains 10% additives that affect the adhesive power produced by the surfactant so that the insecticide sprayed on the parent plant attacked by Thrips pests will result in the insecticide sticking longer to the parent plant so that it can eradicate Thrips pest attacks optimally. The use of additives functions as acidifiers, neutralizers, bleaches, preservatives, emulsifiers and thickeners which aim to maintain product quality and extend the shelf life of the product (Rorong dan Fenny Wilar, 2019).

Based on Table 8 below, the average treatment using insecticides had a significant effect on eggplant harvest yields when compared with the control treatment. According to (Kaimudin, Sumbono, & Istiqomah, 2020) Insecticides are biocides designed to be toxic to certain groups of organisms such as OPT, therefore administering insecticides can increase crop yields because they can eradicate pests, so that crop yields can be increased.

Table 8. Effectiveness of various active insecticide ingredients on eggplant crop yields

Insecticide Treatment	Sample Plot Yield (Kg)
A (Control)	1.90b
B (Abamectin + Surfactant 1ml)	2.53c
C (Abamectin + Surfactant 2ml)	2.46c
D (Dinotefuran + Surfactant 1ml)	3.19f
E (Dinotefuran + Surfactant 2ml)	2.68d
F (Abamectin + Dinotefuran + Surfactant 1ml	3.04e
G (Abamectin + Dinotefuran + Surfactant 2ml	1.86a

Note: Mean values followed by different letters in the same factor and column indicate no significant difference in the Duncan test.

The first harvest was carried out at 56 days after planting, followed by weekly harvests until 70 days after planting. The active ingredients of Dinotefuran, Abamectin, and Surfactant insecticides provided better results compared to the control. The highest yield was obtained from the Dinotefuran insecticide treatment, at 3.19 kg/plot, or equivalent to 3.19 tons per hectare.

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4. CONCLUSSION

The effectiveness of thrips control on eggplant differed among insecticide–surfactant combinations. Treatments combining abamectin and dinotefuran with Ronstick surfactant were more effective than single active ingredient treatments and the control. The abamectin + dinotefuran + surfactant (2 ml/L) treatment was the most effective in suppressing Thrips palmi attack intensity. Practically, this combination can be recommended to farmers as an effective strategy to manage thrips infestation on eggplant while reducing the risk of excessive insecticide application.

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