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Combination of Weed Solution and Concentrate to Control *Thrips sp* and *Aphis sp* Pests in Chrysanthemum Plants

A.A.S. Putri Risa Andriani[1], I Gusti Made Arjana[2] and Ida Bagus Komang Mahardika[3]*

[123]*Agrotechnology Department, Faculty of Agriculture, Science and Technology, Warmadewa University, Denpasar, Indonesia*

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CORRESPONDING AUTHOR

*E-mail: putri_risa69@yahoo.com

A B S T R A C T

Chrysanthemum (Chrysanthemum sp.) is one of the ornamental flower commodities that has high economic value. A significant problem for farmers in cultivating chrysanthemums is the presence of Thrips sp. and Aphis sp. pests. Thrips sp. is an insect pest that attacks plants, while Aphis sp. is an aphid pest. Both of these pests can cause significant losses by directly damaging leaves, reducing plant growth, and affecting flower quality. Conventional pest control methods, such as the use of chemical insecticides, can have negative impacts on the environment and human health, and can cause pest resistance to these chemicals. Several types of weeds, such as Echinochloa crus-galli, Panicum repens, Euphorbia hirta, and Ageratum conyzoides, are known to contain active compounds with insecticidal properties, including tannin content. The purpose of this study was to determine the effect of the combination of weed solution and its concentration in controlling Thrips sp. and Aphis sp. pests on chrysanthemums. The research design employed a Factorial Randomized Block Design, conducted in both the field and a greenhouse, with two factors: Factor I, which was a Combination of weed solutions, and Factor II, which was the concentration of the weed solution. The production data obtained were analyzed using Analysis of Variance, followed by the BNT or Duncan 5% distance test. The quality data of chrysanthemum flowers were compared with SNI 01-4478-1988. The variables observed included the intensity of pest attacks, stem diameter, leaf diameter, plant height, and fresh weight of plants.

Contribution to Sustainable Development Goals (SDGs):
SDG 3:-Good Health and Well-being
SDG 12: Responsible Consumption and Production
SDG 15- Life on Land

1. INTRODUCTION

1.1. Research Background

Chrysanthemums, also known as mums or seruni flowers, are a type of ornamental plant that is quite popular in Indonesia. Chrysanthemums (Dendranthema grandiflora) are ornamental shrubs originating from the plains of China and belong to the Asteraceae family. The advantage of this plant lies in its unique flowers, which come in a variety of sizes and colors. Chrysanthemums are widely known as ornamental plants and complements to various decorations. The need for this commodity has multiple uses, including as decorative materials for rooms, flower vases, tea, flower arrangements, and traditional medicine. Chrysanthemum flowers are classified into two types: spray and standard types [1]. Spray-type chrysanthemums on a single flower stem typically have 10-20 small flowers. At the same time, the standard type on a single chrysanthemum flower stem typically features only one large flower [2].

Efforts to increase the production of chrysanthemum cut flowers, both in quality and quantity, have encountered many obstacles. The obstacles faced are the need for quality seeds that still rely on foreign seeds, the presence of attacks by Plant Pest Organisms (PPOs), and unprofessional institutions. OPT in chrysanthemums can be carried by plants or parts of plants, seeds, or other factors such as host plants around the plantation, wind, groundwater, and planting media. Seeds are the most potent carriers and spreaders of OPT, including both pests and pathogens, as well as latent diseases caused by bacteria, fungi, and viruses [3]. *Thrips sp* and *Aphis sp* are among the main pests of chrysanthemums. Pests can cause significant losses. Pest attacks can cause direct damage to leaves, reduce plant growth, and affect flower quality [4][5][6][7][8]. Therefore, controlling these pests is essential to maintain plant productivity and quality. The presence of Thrips sp is very damaging to chrysanthemums during their development, and plant control has not been carried out [9].

Pest control using chemical insecticides can harm the environment and human health, and may lead to pest resistance to these chemicals. Therefore, there is a need to find more environmentally friendly and sustainable alternatives. One alternative for controlling *Thrips sp.* and *Aphis sp.* pests is to use natural ingredients that are not harmful, such as biopesticides derived from plant materials. Several studies have attempted to use plant extracts from various plants to control Thrips sp. pests. According to Syahbani [10], administering soursop leaf extract at a concentration of 250g/L in water and applying it every 2 days has not been effective in controlling aphid pests (*Aphis sp.)* in the field, with a mortality rate of 29.10% and an efficacy rate of 23.43%.

Extensive research has been conducted on the use of plants as biopesticides. Biopesticides are natural pesticides made from plants that can be used to control pests and diseases in plants. Some examples of plants that can be used to make biopesticides are betel, soursop, and papaya [11]. Soursop leaves contain active ingredients such as annonain and ressin, which are effective in controlling pests like aphids and blast disease. In contrast, papaya leaves contain a group of cysteine protease enzymes such as papain and chymopapain, as well as terpenoids, flavonoids, and non-protein amino acids that are toxic to plant-eating insects [12]. Biopesticides have several advantages over chemical pesticides, including not harming natural enemies of pests, minimizing environmental damage, and reducing the risk of pest resistance. Biopesticides are also relatively safe for humans and animals, have low phytotoxicity, and are cheap and easy to make by farmers. Weeds also contain bioactive compounds that can be utilised as biopesticides.

Several types of weeds, such as Echinochloa crus-galli, Panicum repens, Euphorbia hirta, and Ageratum conyzoides, are known to contain active compounds with insecticidal properties, including tannin content [13]. Tannin levels in weeds Echonocloa crusgali, Panicum repen, Euphorbia hirta, Ageratum conyzoides, and Imperata Cilindrica are 10884.35 mg TAE/100 grams, 6891.15 mg TAE/100 grams, 2654.18 mg TAE/100 grams, 5125.32 mg TAE/100 grams, and 4843.8167 mg TAE/100 grams, respectively [13]. Tannin is a macromolecular compound produced by plants that acts as an antinutrient and enzyme inhibitor, resulting in reduced starch hydrolysis and a lower response to blood sugar in animals [14]. In line with Mardiana's opinion [15], tannin compounds are phenolic compounds that are polymerizations of simple polyphenols. These compounds are found in almost two groups, namely hydrolyzable tannins and condensed tannins. This substance is generally used to lower blood glucose levels by stimulating glucose and fat metabolism, as an antiseptic, a burn medicine, as an antidote in cases of alkaloid poisoning, to stop minor bleeding, and to stop diarrhea. Additionally, the use of tannin compounds can cause water absorption in the organism's body, potentially leading to dehydration and death, as the body lacks sufficient water.

Different types of weeds may contain active compounds with various effects on aphids, so they need to be combined to achieve optimal results. Furthermore, the concentration of the solution can also affect its effectiveness and safety. In the context of modern, evidence-based agriculture, in-depth research is needed to provide empirical evidence regarding the efficacy and safety of using a combination of weed solutions to control Thrips sp. and Aphis sp. pests in chrysanthemums. The novelty of this research lies in the optimal combination of weed solutions and the correct concentration to control Thrips sp. and Aphis sp. pests in chrysanthemums.

1.2. Research Objective

This study aimed to determine the effect of combining weed solutions and their concentrations on controlling Thrips sp. and Aphis sp. pests in chrysanthemums.

2. MATERIALS AND METHODS

The research was conducted in Pancasari Village, Sukasada District, Buleleng Regency, at an elevation of 1,247 meters above sea level and an average temperature of 17°C to 20°C. The study will be conducted at a partner site. The study is planned to last one year, from February to September 2025.

The research method employed a Nested Randomized Block Design, carried out in the field and in a greenhouse, with two factors: Factor I, a Combination of Weed Solutions, and Factor II, the concentration of biopesticides. Factor I is the type of Weed Solution, including a combination of Ageratum conyzoides weed solution: Echonocloa crusgali weed solution (B1), a combination of Ageratum conyzoides weed solution: Panikum repen weed solution (B2), a combination of Ageratum conyzoides weed solution: Euphorbia hirta weed solution (B3), and a Combination of Ageratum conyzoides weed solution: Imperata Cilindrica weed solution B4. Factor II refers to the concentration of the weed solution, specifically 200 grams/liter (K1), 250 grams/liter (K2), and 300 grams/liter (K3).

The implementation of the experiment involves preparing planting media, fertilizing, planting, treating, maintaining plants (watering, replanting, weeding), observing plant growth and development, and harvesting, as well as data analysis.

The plant maintenance carried out involved the application of a fungicide with active ingredients of azoxystrobin (200 g/L) and difenoconazole (125 g/L) to prevent rust disease. The application was carried out every 1 week with a concentration of 1 ml/l. Weeding was carried out weekly, while watering was done daily. Additional lighting was initiated from planting, carried out 4 hours per day for 1 month, from 22:00 to 02:00 am, using 75-watt incandescent lamps installed at a distance of 3 m between lamps and a height of 1 m above the plant canopy. Bioinsecticides were tested to control pest attacks by *Thrips sp.* and *Aphis sp.* at concentrations according to the treatment. Treatment was carried

out when the plants were 2 months old by spraying them with a solution on all parts of the plant. The application was carried out once a week in the afternoon, from planting until harvest, a total of four applications.

The variables observed include the length of the flower stalk, weight of the flower stalk, flower diameter, economic weight of fresh flowers per plant, and the number of infected leaves, as well as the intensity of the attack (as calculated using the formula below).

For attack intensity, the formula used is:

$$IS = \frac{\sum(n \times v)}{Z \times N} \times 100\%$$

Information :

IS= Attack intensity

n = Number of damaged leaves per attack category

v = Scale value of each attack category

Z = Highest category scale value of attack category

N = Number of leaves observed

Category	Level of attack on plants (%)
Light	If the attack rate is ≤ 10%
Currently	If the attack rate is ≤ 25%
Heavy	If the attack rate is ≤ 85%
Failure	If the attack rate is > 85%

Source: Directorate of Food Crop Protection 2021

The production data obtained were analysed using Variance analysis and followed by the BNT or Duncan 5% distance test, while the chrysanthemum flower quality data were compared with SNI 01-4478-1988.

3. RESULTS AND DISCUSSION

Analysis of variance revealed that the type of gum solution treatment did not have a significant effect on chrysanthemum production and yield. Meanwhile, the concentration treatment showed a slight to very significant effect on chrysanthemum yield and production. The significance of the analysis of variance results, which examine the influence of the type of weed solution and concentration on controlling aphid pests on chrysanthemum plants, is evident in Table 1.

Use of weeds Echonocloa crus-galli. At different concentrations, it had a significant to very significant effect on the variables of stem length, stem weight, flower diameter, and fresh weight of economic flowers. Weeds, particularly Panicum repens, when applied to chrysanthemum plants at varying concentrations, had a significant effect on the variables of stem weight, flower diameter, and fresh weight of economic flowers. Weeds, specifically Euphorbia hirta, given to chrysanthemum plants at different concentrations, had a significant to very significant effect on the variables of stem length, stem weight, flower diameter, fresh weight of economic flowers, and the number of infected leaves. Meanwhile, the use of weeds Ageratum conyzoides at different concentrations has a real to very real effect on the variables of stem length, flower diameter, and fresh weight of economic flowers.

Table 1. Significance of Variance Analysis Results of the Influence of Weed Solution Type and Concentration on Control of Aphid Pests on Chrysanthemum Plants

	Variables	Weed solution type (G)	The Effect of Concentration on Each Type of Weed Solution			
			K dl Gec	K dl Gpr	K dl Geh	K dl Gac
1	Flower stem length (cm)	ns	**	ns	**	**
2	Flower stalk weight (g)	ns	*	**	**	Ns
3	Flower Diameter (cm)	ns	**	**	*	**
4	Fresh weight of economic flowers (g)	ns	*	**	**	*
5	Number of Infected Leaves (%)	ns	Ns	ns	*	Ns

Information :

* = significantly affected

** = very significant effect

ns = not real

Gec = weed Echonocloa crusgali

GPR = Panicum repens weed

Geh = Euphorbia hirta weed

Gac = weed Ageratum conyzoides

This study used four types of weeds with insecticidal properties to control aphid pests on chrysanthemums. The types of weeds used were Echinochloa crus-galli, Panicum repens, Euphorbia hirta, and Ageratum conyzoides. Before the glume solution treatment, the intensity of leaf pest attacks on chrysanthemums reached >35%. This type of weed treatment was able to reduce aphid attacks on chrysanthemums to around 15-17%. The study's results are presented in Table 3. The mechanism of solutions made from weeds with insecticidal properties in reducing aphid attacks on chrysanthemums generally involves bioactive compounds contained in the weeds, which function as poisons or inhibitors for aphids [16]. Weeds such as Echinochloa crus-galli, Panicum repens, Euphorbia hirta, and Ageratum conyzoides contain secondary metabolites or bioactive compounds, including alkaloids, flavonoids, phenolics, and terpenoids, which possess natural insecticidal properties. This compound can disrupt the metabolic and physiological systems of aphid pests, thereby directly suppressing the aphid population [17]. The insecticidal compound from this plant works as a contact poison and a stomach poison for aphids. The contact poison causes physical damage or respiratory problems in aphids when exposed to the spray solution. In contrast, the stomach poison works if the aphids eat parts of the plant that have been coated with the insecticidal compound, so that the aphids experience internal organ damage and death [18].

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Table 2. Effect of types of weed solution and concentrations of each type of weed solution on the average length of flower stalks (cm), weight of flower stalks (g), and flower diameter (cm)

The influence of weed solution types			
Treatment	Flower stem length (cm)	Flower stalk weight (g)	Flower Diameter (cm)
Gec	80.25a	366.00a	4.33a
Gpr	72.58a	340.00a	4.41a
Geh	77.17a	358.75a	4.31a
Gac	80.25a	396.25a	4.44a
BNT 5%	ns	ns	Ns
The effect between the concentration of each type of weed solution			
K dl Gec			
K1	95.67 b	450.67b	5.33 b
K2	105.33 ab	480.00b	5.73ab
K3	120.00 a	533.33 a	6.27a
K dl Gpr			
K1	94.33 a	413.33b	5.57 b
K2	95.67 a	403.33b	5.63 b
K3	100.33 a	543.33a	6.43 a
K dl Geh			
K1	94.67 b	411.67 b	5.40 b
K2	96.00 b	483.33ab	5.80 b
K3	118.00 a	540.00 a	6.03 a
K dl Gac			
K1	89.67 c	496.67 a	5.50b
K2	100.00 bc	530.00 a	5.90ab
K3	123.33 a	558.33 a	6.37a
BNT 5%	18,441	89,743	0.61

Description: The numbers in the same column for each factor followed by the same letter are not significantly different in the BNT test at the 5% level.

Table 3. Effect between types of weed solution and between concentrations of each type of weed solution on the average fresh weight of economic flowers (g) and the number of infected leaves (%)

The influence of weed solution types		
Treatment	Fresh weight of economic flowers (g)	Number of Infected Leaves (%)
Gec	336.85 a	17.25 a
Gpr	306.67a	17.92 a
Geh	338.33a	17.42 a
Gac	372.08a	15.33 a
BNT 5%	Ns	ns
The effect between the concentration of each type of weed solution		
K dl Gec		
K1	420.73 b	25.00 a
K2	436.67 b	24.67 a
K3	490.00 a	19.33 a
K dl Gpr		
K1	353.33 b	25.67 a
K2	380.00 b	25.00 a
K3	493.33 a	21.00 a
K dl Geh		
K1	383.33 b	27.67 a
K2	453.33 ab	22.33b
K3	516.67 a	19.67b
K dl Gac		
K1	456.67 b	21.00 a
K2	496.67ab	20.33 a
K3	535.00a	20.00 a
BNT 5%	66.74	4,366

Description: The numbers in the same column for each factor followed by the same letter are not significantly different in the BNT test at the 5% level.

In this study, Ageratum conyzoides weeds demonstrated the most remarkable ability to control aphid pests, with the smallest number of infected leaves, specifically 15.33%. Although this difference was not statistically significant compared to other types of weeds, it is notable. The administration of Ageratum conyzoides I weed solution resulted in the highest fresh weight of economic flowers, namely 372.08 g, the highest flower stalk length of 80.25 cm, the highest flower stalk weight of 396.25 g, and the highest flower diameter of 4.44 cm. This shows that the use of Ageratum conyzoides weed solution can control chrysanthemum flower aphid pests, thereby increasing chrysanthemum flower production and yield. The insignificant difference produced by this weed solution is likely due to the active insecticide compounds in each type of weed tested having relatively similar control effectiveness [19], resulting in statistically insignificant differences.

The application of weed control solutions at different concentrations significantly affected the production and yield of chrysanthemums. Higher-concentration weed control solutions resulted in increased stem length, stem weight, stem diameter, and economic fresh weight, as well as a lower number of infected leaves. Higher concentration weed control solutions contained a greater number of insecticidal bioactive compounds, thus having a more substantial effect in controlling aphid pests [20]. Consequently, chrysanthemums experienced lower pest attacks (the number of infected leaves decreased), allowing for optimal plant growth. With reduced pest attacks, chrysanthemums could allocate more resources to vegetative and generative growth [21]. This resulted in increased flower stalk size and mass, which are indicators of better plant growth. Increased economic fresh weight (fresh weight of economically valuable plant parts, such as flowers) indicated better production results [22]. This suggests that pest control with high-concentration weed control solutions supports better chrysanthemum yields in terms of quantity and quality.

4. CONCLUSION

Analysis of variance showed that the type of gum solution treatment did not significantly affect chrysanthemum production and yield. Meanwhile, the concentration treatment showed a slight to very significant effect on chrysanthemum yield and output. Ageratum conyzoides weed exhibits the most remarkable ability to control aphid pests, with the smallest number of infected leaves, specifically 15.33%. However, this difference is not statistically significant compared to other types of weeds. The administration of Ageratum conyzoides I weed solution resulted in the highest fresh weight of economic flowers, namely 372.08 g, the highest flower stalk length of 80.25 cm, the highest flower stalk weight of 396.25 g, and the highest flower diameter of 4.44 cm.

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