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MICROBABITAT MANAGEMENT WITH VARIOUS REFUGIA PLANTS IN WHITEFLIES (Bemisia tabaci Gennadius) CONTROL ON SEVERAL VARIETIES OF RED CHILI (Capsicum annum L.)

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Abstract

This research has been conducted in Simalingkar B, Medan Tuntungan Sub-district, Medan, North Sumatra with flat topography. This research started from May to August 2025. This research was supervised by Prof. Dr. Ir. Asmanizar, MP. As the chief supervisor and Prof. Dr. Ir. Nurhayati, MP. as a supervising member. This research is to determine the effect of flowers of tagetes erecta and zinnia sp as refugia plants on the presence of natural enemies of chili plants in controlling whitefly pests and tough varieties, sios tavi and local to whitefly pest attacks. This study used the Separate Plots Design (RPT) research method with two factors, namely refugia and varieties. The first factor consists of 3 levels, namely: R0 = control, R1 = tagetes erecta, R2 = zinnia sp. The second factor of varieties consists of 3 levels, namely: V1 = tough, V2 = sios tavi, R3 = local. The parameters observed were the intensity of Bemisia tabaci attack, natural enemies and production per plot. The results showed that refugia had a significant effect on production per plot, the variety treatment had no significant effect on the intensity of Bemisia tabaci attack and production per plot. The interaction of varieties and refugia had no significant effect on all observations.

Keywords**:** ***chili, varieties, refugia.***

INTRODUCTION

Red chili (Capsicum annum L.) is an important horticultural commodity in Indonesia due to its high economic value and widespread consumption in various levels of society. The demand for red chili continues to increase along with population growth and national consumption needs (Astutik et al., 2018). In addition to being a cooking flavoring, chili also has high nutritional value, such as vitamins A and C, and capsaicin compounds that provide a spicy taste as well as health benefits (Ramdani et al., 2018). However, the productivity of red chili often faces major challenges due to plant pests (OPT), especially whitefly pests (Bemisia tabaci Gennadius). This pest not only causes direct damage through sucking plant fluids, but also acts as a vector for the spread of viruses such as the very detrimental Gemini virus (Hasyim et al., 2015). Damage due to viral infections transmitted by B. tabaci can even cause crop losses of up to 100%.

One of the causes of the high population of this pest is the monoculture planting system commonly applied by farmers. This system makes it easier for pests to find hosts and increases their reproductive and spreading power (Wahyuni et al., 2018). As an alternative to the use of synthetic pesticides that have a negative impact on the environment and human health, ecological approaches such as the use of refugia plants have begun to be widely developed. Refugia plants function as microhabitats for natural enemies (predators and parasitoids) to approach their prey, thus potentially suppressing pest populations naturally (Balmer et al., 2013). Refugia plants such as Tagetes erecta (chicken dung flower) and Zinnia sp. have colors and aromas that are attractive to insects, especially natural enemies of pests. In addition to being a source of nectar and pollen, refugia also provide protection and breeding grounds for predators (Kurniawati & Edhi, 2015). Increased biodiversity through refugia plants is believed to create a more balanced and sustainable agroecosystem, and minimize dependence on chemical inputs (Fitriani, 2016). In addition, the effectiveness of refugia plants in controlling pests also depends on the interaction with the chili plant varieties used. Different varieties show varying levels of susceptibility to pest attacks. Superior varieties have higher resistance and have the potential to increase the effectiveness of integration between cultivation techniques and conservation of natural enemies (Andriana, 2019). Based on this background, this study

aims to examine the effectiveness of microhabitat management using various refugia plants in controlling Bemisia tabaci pests on several varieties of red chili. This study is expected to contribute to the development of environmentally friendly agricultural technology based on ecology and support the increase in red chili productivity in a sustainable manner.

LITERATURE REVIEW

Red Chili Plant (Capsicum annum L.)

Red chili plants are important horticultural plants that are widely cultivated in Indonesia. Red chili has high economic value and plays an important role in the national food system. In addition to being a flavoring agent, chili also contains capsaicin compounds that act as antioxidants and provide a spicy taste (Prayudi, 2010). This plant is susceptible to various attacks by plant pests (OPT), one of which is Bemisia tabaci, which can damage the quality and quantity of the harvest.

Bemisia tabaci Pest and Its Impact

Bemisia tabaci (whitefly) is an important pest that attacks chili plants. This pest causes direct damage through sucking plant fluids and indirect damage as a vector of the very detrimental Gemini virus (Hasyim et al., 2015). The increase in the population of this pest is influenced by the monoculture cultivation system that supports the continuous availability of food and egg-laying sites. The population of B. tabaci tends to increase until the plant is 63–77 days old, then decreases when the plant is no longer optimal as a host (Yuliani et al., 2006). Controlling this pest requires an ecological approach to minimize the use of chemical pesticides that have a negative impact on the environment.

Refugia Plants as Natural Enemy Conservation

Refugia are plants or weeds planted around cultivated plants and function as microhabitats for natural enemies such as predators and parasitoids. Refugia support the conservation of natural enemies by providing food sources in the form of nectar, shelter, and breeding sites (Balmer et al., 2013). The presence of refugia has been shown to increase biodiversity and stability of agricultural ecosystems. According to Kurniawati and Edhi (2015), flowering plants used as refugia can attract predatory and parasitoid insects that help control pests. In addition, Purwantiningsih et al. (2012) suggested that refugia be planted earlier than the main crop to provide adaptation time for beneficial insects.

Effectiveness of Zinnia sp. as Refugia

Zinnia sp. or paper flower is a potential refugia plant because it is easy to grow, has various colors, and flowers continuously. The color and aroma of the flowers can attract many types of beneficial insects, including predators and parasitoids. This plant also contains active compounds such as flavonoids, tannins, and phenols that play a role in insect ecology (Asmaa et al., 2015). Widia (2019) stated that Zinnia sp. functions as a shelter and food source for natural enemies. Research by Sejati (2010) shows that Zinnia elegans is able to attract insects from various families, such as Formicidae and Coccinellidae.

Effectiveness of Tagetes erecta as Refugia

Tagetes erecta (marigold) is widely known as a pest repellent plant because it contains strong-smelling compounds that insects dislike. In addition, this plant contains carotenoids, flavonoids, and polyphenols that support plant health and repel pests (Lisdayani, 2018). Erdiansyah et al. (2018) found that the use of T. erecta as a refugia can increase the population of natural enemies, especially in organic farming areas. Tagetes is often used as a border plant in intercropping systems because of its repellent effect on various pests such as Aphis craccivora and Plutella xylostella.

Interaction of Refugia and Variety on Pest Control

The combination of refugia and plant varieties can affect the effectiveness of pest control. Although in Yunita's study the interaction between chili varieties and refugia did not show a significant effect on the intensity of B. tabaci attacks, the presence of refugia was still able to increase the population of natural enemies such as Oxyopes salticius and Epilachna sp. According to Arofah and Tjahjaningrum (2013), habitat manipulation with refugia can increase the diversity of beneficial insects which indirectly contributes to pest control and increased crop production.

METHOD

Place and Time of Research

This research was conducted in Tanjung Gusta Village, Medan Helvetia District, Medan City, North Sumatra. The research activities lasted for four months, namely from August to November 2024. The selection of the location was based on the suitability of the land agroecosystem with the needs of chili plants and refugia, as well as accessibility for observation activities.

Materials and tools

The materials used in this study include chili seeds from three varieties, namely F1 Tangguh, Sios Tavi, and local varieties; refugia plant seeds such as Tagetes erecta (chicken dung flower), Zinnia sp., and Cosmos caudatus; compost fertilizer from city waste and pearl NPK fertilizer. The tools used include hoes, watering cans, meters, handsprayer, plastic ropes, scales, and other tools to support the planting and observation process.

Research methods

This study used a Split Plot Design (RPT) with two factors. The main factor is the type of refugia plant (R), which consists of three levels:

- R0: No refugia (control)
- R1: Tagetes erecta
- R2: Zinnia sp.

The second factor is the chili variety (V), which also consists of three levels:

- V1: Lado F1 Variety
- V2: Sios Tavi Variety
- V3: Local Varieties

Thus, there were 9 treatment combinations repeated 3 times, resulting in a total of 27 experimental plots. The number of chili plants per plot was 40, so that the total number of plants observed reached 1,080 plants.

Research Implementation

The land is cultivated with a tractor and loosened using a hoe. The beds are made with a length of 5 meters and a width of 1.1 meters. Refugia planting is done two weeks before planting chilies so that beneficial insects have time to adapt. Chilies are planted with a planting distance of 50 cm × 50 cm. Basic fertilization uses manure and NPK according to recommendations, while watering and weeding are carried out routinely according to field needs.

RESULTS AND DISCUSSION

Bemisia tabaci Attack Intensity

Table 1. Bemisia tabaci attack intensity 2-6 MST

Treatment	Plant Age (MST)				
	2 MST	3 MST	4 MST	5 MST	6 MST
Refuge					
Control	2.08	3.47	4.17	15.97	22.92
Tagetes erecta	0.69	0.69	1.39	8.33	13.89
Zinia sp	0.69	0.69	3.47	9.03	15.28
Varieties					
F1 Lado	1.39	1.39	2.08	11.11	14.58
Sios Tavi	1.39	1.39	2.78	13.19	20.83
Local	0.69	2.08	4.17	9.03	16.67
Interaction					

Description: Numbers followed by the same letter indicate no significant difference.
5% level.

Table 1, the results of the Analysis of Variance test at the 5% level can be seen that the refugia treatment did not have a significant effect on the intensity of Bemisia tabaci attacks. However, the highest attack intensity was in the control treatment, which was 22.92% and the lowest average was in the Tagetes erecta flower treatment, which was 13.89%. Likewise, the variety treatment that did not have a significant effect on the highest attack intensity was in the sios tavi variety treatment, which was 20.83% and the lowest average was in the F1 Lado variety treatment, which was 14.58%. Likewise, there was no interaction between refugia flowers and varieties.

The absence of significant effects of refugia and variety treatments on the intensity of Bemisia tabaci attacks indicates that the presence of refugia plants in this experimental design was not strong enough to significantly reduce the pest population in a short time. This may be influenced by the adaptation period of natural enemies to the new habitat or climate conditions that are less supportive of predator activity. The presence of refugia has been shown to increase the diversity of natural enemies such as Oxyopes salticius and Epilachna sp., which in theory support biological control. This is in accordance with the concept of agricultural ecology which states that vegetation complexity increases the abundance and effectiveness of natural enemies (Landis et al., 2000). However, this increase in natural enemies did not directly reduce the intensity of pest attacks in the limited observation period.

Number of Natural Enemies

Table 2. Identification results

No	Order	Family	Genus	Species	Information	Amount
1	Coleoptera	Coccinellidae	Menochillus	*Menochillus sexmaculutus*	Predators	21
2	Coleoptera	Coccinellidae	Verandah	*Verania lineara*	Predators	9
3	Hemiptera	Pentatomidae	Geocorydae	*Geocory* sp	Predators	15
4	Diptera	Tachinidae	Vibrissae	*Vibrissae* sp.	Predators	20
5	Araneae	Agelenidae	Aglaonema	*Agelenopsis aperta*	Predators	23
6	Araneae	Oxyopidae	Oxytopes	*Oxyopes salticius*	Predators	36
7	Odonata	Coenagrionidae		*Ischnura*	Predators	35

Table 2, found as many as 6 different families. In the abundance of natural enemies, the orders Coleoptera, Pentatomidae, Hemiptera, Diptera, Araneae and Odonata were found. The order that most often visited was the Araneae order. Several types of predators were found, namely Epilachna sp (Coleoptera) 40, Menochillus sexmaculutus (Coleoptera) 21, Verania lineata (Coleoptera) 9, Geocory sp (Hemiptera) 15, Vibrissina sp (Diptera) 20, Agelenopsis aperta (Araneae) 23, Oxyopes salticius (Araneae) 36, Ischnura (Odonata) 35.

Production Per Plot

Treatment	Plant Age (MST)	
	Harvest 1	Harvest 2
Refuge		
Control	92.44	112.44
Tagetes erecta	111.33	131.33
Zinnia sp	119.00	139.00
Varieties		
Lado F1	103.78	128.78
Sios Tavi	108.78	123.78
Local	110.22	130.22
Interaction		

Description: Numbers followed by the same letter indicate no significant difference at the 5% level according to Duncan's test.

Based on Table 3, the results of the Analysis of Variance test at the 5% level can be seen that the refugia treatment did not significantly affect the production per plot. The highest production in the second harvest of the Zinnia sp refugia treatment was 139.00 g/plot which was not significantly different from the control, which was 112.44 g/plot. In the variety treatment that did not significantly affect the highest production per plot, the local variety treatment was 130.22 g/plot and the lowest average was the sios tavi variety treatment of 123.78 g/plot. Likewise, there was no interaction between refugia flowers and varieties.

This is because the variety of refugia plants in the planting area can reduce the attack of B. tabaci pests so that production increases. The variety of refugia plants in a planting area can increase the number of natural enemies in a planting area. According to Setiawati and Asandi, 2003, some types of plants that act as companion planting can be used to reduce the attack of B. tabaci, including intercropping of chili and tagetes, and planting corn or wheat near chili plants. Fusarium wilt disease is a soil-borne disease that attacks the xylem of the host plant. F. oxysporum spores enter the plant through penetration of the spore propagules through wounds in the roots. The F. oxysporum fungus produces hydrolytic enzymes that facilitate the spore penetration process. Fungal spores will grow to form mycelium in the root cortex and then penetrate the endodermis. The mycelium of the F. oxysporum fungus in the endodermis will produce pectolytic enzymes. This enzyme can break down pectin in the xylem cell walls and middle lamella. The fungal hyphae then enter the xylem through the pith rays. The reproductive organs of microconidia will be produced by the mycelium in the xylem, then will be carried by the vertical flow of water, so that the microconidia are spread throughout the xylem channel. Microconidia will grow to germinate to form hyphae and continue the colonization process (Okungbowa and Shittu, 2016). As a result of the presence of hyphae in the xylem section, it will inhibit the transport of water and nutrients to the upper part of the plant, causing the part of the plant that does not receive nutrients to be damaged and unable to function normally. This results in the plant not being able to grow properly and the plant organs not developing normally (Susanna et al., 2009).

CONCLUSION

1. The refugia plants Tagetes erecta and Zinnia sp did not have a significant effect on the intensity of Bemisia tabaci attacks and red chili production in short-term observations, but showed a tendency for an increase in the presence of natural enemies in the treatment land.
2. Red chili varieties (Lado F1, Sios Tavi, and local) did not show significant differences in Bemisia tabaci attacks or production results, indicating that the resistance of the varieties to this pest is relatively equivalent under test conditions.
3. There was no significant interaction between refugia plants and varieties on pest attack intensity and production results, but the potential for long-term synergy remains open for further study.

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