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Research Article

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Identification of Ectoparasites on Aglaonema sp. in Ngerong Village, Pasuruan City with Visual Encounter Methods

Silvi Zakiyatul Ilmiyah[1,2], Afif Eka Rahma Setiyanto[1,3], Yudhistira Ibrahim[1)], Bagyo Yanuwiadi[4)], Zulfaidah Penata Gama[4))]*

[1)]*Bachelor Program in Biology Department, Faculty of Mathematics and Natural Sciences, Universitas Brawijaya*
[2)]*Master Program in Biomedical Sciences, Faculty of Medicine, Universitas Brawijaya*
[3)]*Master Program in Biology Department, Faculty of Mathematics and Natural Sciences, Universitas Brawijaya*
[4)]*Biology Department, Faculty of Mathematics and Natural Sciences, Universitas Brawijaya*

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[*)]CORRESPONDENCE

email: gama@ub.ac.id

A B S T R A C T

Aglaonema sp., known as Sri Rejeki, is an ornamental plant which enjoyed in terms of leaf pattern. However, Aglaonema has harmful ectoparasites that caused damage on it. The aim of this study was to determine and identify ectoparasites in Aglaonema plants using the Visual Encounter method in Ngerong Village, Pasuruan City and analyze the role and solutions for the presence of ectoparasites in Aglaonema. Research observations were carried out for approximately three weeks from April to May 2022. There were 50 individuals Aglaonema observed. Observation was carried out one day in a week in the morning, afternoon, and evening with a total of three times observations. Measurement of abiotic factors includes temperature, humidity, and weather. Arthropods were observed analyzed with important value index (IVI) and Shannon-Wiener Index (H'). The prevalence was 12%. All identified organisms were arthropods (insects). There were five identified families: Pseudococcidae, Coccidae, Formicidae, Chironomidae, and Muscidae. Pseudococcidae and Coccidae are the insect families that are confirmed as ectoparasites for plants. Coccidae had IVI value 122.09% and H' value 0.04 on first week. Pseudococcidae had IVI value 25.97% and H' value 0.06 on first week. The solution for prevention or termination of ectoparasite is by replacing the invaded plant away from healthy plants, removing the infected parts of plant, and/or placing refugia plant for habitat of ectoparasite's natural enemies.

INTRODUCTION

Ornamental plants are plants that are used to decorate the home page, office spaces, hotels, restaurants, and city parks. Ornamental plants have a beautiful appeal. This potential attracts people who see it both for hobbies and just to enjoy the beauty. Aspects of the beauty that can be enjoyed from ornamental plants are the unique fruit, dazzling shape and color of the flower crown, charming crown shape, unique leaf color, etc. (Lestari and Kencana, 2008). Ornamental plants are inseparable from the function of tourism, such as in Pasuruan City. Pasuruan has a flower village tour in Pucangan. In addition, Pasuruan also has several city parks such as Sekargadung Park, Pekuncen Park, and City Park (Taman Kota) (Pasuruan City Goverment, 2022)

Aglaonema sp. is among the selection of ornamental plants. The Aglaonema plant is commonly referred to as Sri Rejeki due to its association with auspiciousness and fortune. Aglaonema is sometimes referred to as Chinese Evergreen because to its historical association with Chinese growers. The Aglaonema plant is believed to have its origins in either South Asia or Southeast Asia. The suitable habitat for Aglaonema is lowland and medium plains with light intensity of around 10-30%. Aglaonema is enjoyed as an ornamental plant in terms of leaf patterns, namely green, white, red, orange, etc. (Djojokusumo, 2007). Aglaonema has benefits such as curing fever, being anti-inflammatory, and absorbing airborne pollutants such as toluene, hexane, TCE (Islam et al., 2019). People in Pasuruan like Aglonema which is shown by Aglonema production in 2022 was 11,969 individuals (Statistics East Java, 2023).

It is undeniable that Aglaonema has parasites or pests. The parasite is certainly detrimental to its host. So far there is still not much reported data on the prevalence of ectoparasites on ornamental plants such as Aglonema, so this research is important. An

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example of parasites on Aglaonema is mealybugs. Mealybugs suck the sap of the Aglaonema plant. The parts of the plant that can be attacked by mealybugs are flower axils, leaf axils, and the undersides of young leaves. The effect of the mealybugs attack is disrupted plant growth (Djojokusumo, 2007). Another effect is decrease the aesthetic value of plant due to the damaged appearance of the plant (Mani & Shivaraju, 2016).

Research on dry rot disease on Aglaonema caused by *Fusarium* was done by Ismahmudi et al. (2021) and Zhang et al. (2022). There are several studies about ectoparasites or pest attacks on agricultural plants in Pasuruan (Widiastuti et al., 2014 ; Intarti et al., 2020 ; Nasirudin and Yuliana, 2020 ; Musarofa et al., 2023). However, the identification of ectoparasites' attack on ornamental plants especially Aglaonema in Pasuruan never been reported. Therefore, this study aimed to identify ectoparasites in Aglaonema using the Visual Encounter method in Ngerong Village, Pasuruan City and analyze the role and solutions for the presence of ectoparasites in Aglaonema.

MATERIAL AND METHODS

Time and Place

Observations were done in three weeks from April to May 2022. The observation location is Pondok Pesantren Salafiyyah Al Faqih Pucang, Ngerong Village, Gempol, Pasuruan.

Sample Preparation and Tools

This observation was carried out using 50 individuals *Aglaonema* sp. Some of the tools used in this observation include a magnifying glass or loupe, stationery, observation sheets, stereo microscope, a binocular microscope, and smartphones.

Observation Activities

The method used in this research was visual encounter. Observations were done within 3 weeks. Each week observed one day in the morning (07.00), noon (12.00) and afternoon (16.00). Each time observed with three repetitions with a duration of 15 minutes in every repetition. The distance between the observer and the plants was about 1 m. Ectoparasites on Aglaonema were observed directly with a loupe if the ectoparasites are small and difficult to observe directly with the eye (Muhibah and Leksono, 2015). The abiotic environmental factors that are measured include temperature, humidity, and weather with the weather application. Measurement of abiotic environmental factors was carried out prior to observation.

Data Identification and Analysis

The ectoparasites obtained were documented by photographing and recording using a smartphone, observed by stereo microscope and binocular microscope, and identified the families of ectoparasites using various journal articles and textbooks. The ectoparasites data obtained was further processed with Microsoft Office Excel to analyze the prevalence, abundance, and diversity of the ectoparasites found. The equation for determining prevalence is (Siagian et al., 2023) :

$$\text{Prevalence} = \frac{Number\ of\ Aglonema\ infected}{Total\ Aglaonema\ obseved} \times 100$$

The calculations used to determine the level of diversity of ectoparasites are the Important Value Index (IVI) and the Shannon-Wiener Index. The equation of the Important Value Index (Syarifuddin et al., 2017) is:

IVI = Relative Density (RD) + Relative Frequency (RF)

$$\text{RF (\%)} = \frac{Frequency\ of\ a\ family}{Total\ frequency\ of\ all\ family} \times 100$$

$$\text{F} = \frac{Area\ of\ plots\ in\ which\ a\ family\ occurs}{Total\ area\ sampled}$$

$$\text{RD (\%)} = \frac{Density\ of\ a\ family}{Total\ density\ of\ all\ family} \times 100$$

$$\text{Density} = \frac{Number\ of\ a\ family}{Total\ area\ sampled}$$

The equation of the Shannon-Wiener Index is :

$$H' = -\Sigma_{i=1}^{n} \left(\frac{ni}{N}\right) \left(ln\frac{ni}{N}\right)$$

The results of this analysis will be used in comparing the differences regarding the presence of ectoparasites in Aglaonema.

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Research Article

RESULT AND DISCUSSION

Prevalence Ectoparasites on Aglaonema

Total infected Aglaonema which were observed for three weeks was six individuals from 50 individuals total. Based on prevalence calculations, it is known that the prevalence of ectoparasites in Aglaonema sp. in Ngerong Village, Pasuruan was 12%. Based on Williams & Williams (1996), the prevalence of infection is classified as frequently.

Observed Arthropods and Their Roles

There were five families arthropods observed in Aglaonema. Brown dots observed on the leaves observed in macroscopy (Fig. 1A) and observed with a stereomicroscope (Fig. 1F) assumed from the Coccidae family. Arthropod observed that alighted on leaves was the Chironomidae family (Fig. 1B). The other arthropods observed with a binocular microscope were the Pseudococcidae family (Fig. 1C), Muscidae family (Fig. 1D), and Formicidae family (Fig. 1E). Among five families, there are two families categorized as ectoparasites, Pseudococcidae and Coccidae. These two families are known as scale insects (Kakoti et al., 2023).

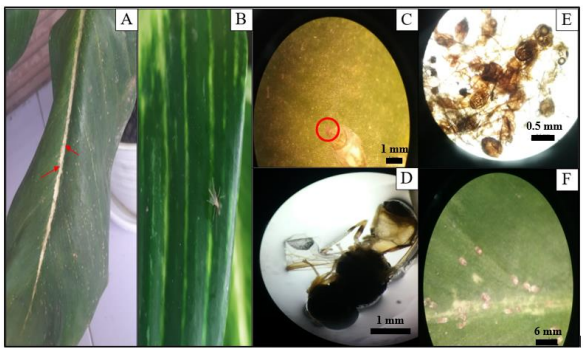

Figure 1. Arthropods observed (A and F) Coccidae, (B) Chironomidae, (C) Pseudococcidae, (D) Muscidae, (E) Formicidae

Pseudococcidae is a family of arthropods that are generally oval in shape and include scaly insects (Eaton and Kaufman, 2007). Pseudococcidae are more commonly known as mealybugs and have become one of the insect pests that cause much damage to plants because of their nature as ectoparasites. This damage affects not only the field of ornamental plants but also the field of agricultural crops which causes a lot of losses to the growers or gardeners. The presence of mealybugs can also be found in the root area of plants in the soil which can worsen the condition of plants and is a threat that is quite difficult to detect with the naked eye because plant roots must be removed from the soil to observe the presence of Pseudococcidae on plant roots (Malan and Hatting, 2015).

Coccidae (plant lice) is a group of insects that act as many pests, are polyphagous and have a wide host range. It was polyphagous in 48% of cases on gymnosperms and 37% of cases on angiosperms. Eight species of Coccidae were reported as exceptionally polyphagous due to eating various plants from more than 50 families. This Coccidae commonly attacks ornamental plants and plants in the yard. (Kakoti et al., 2023 ; Sumartayasa et al., 2021).

Scale insects attack resulting in a lack of plant vigor due to it imbibing the sap in large quantities from the leaves and stems of plants. The other effects of low sap quantities are early leaf drop and dieback of twigs and branches (Gill and Kosztarab, 1997 ; Sumartayasa et al., 2021). Scale insects secrete honeydew during feed onto the leaf and stem. Honeydew becomes a medium for the growth of soot mold causing a “sooty” black look on plants (Kakoti et al., 2023). The soot mold covers the leaf involve sunlight can’t be absorbed by the leaf. The lack of light received by leaves causes decreasing photosynthesis, which inhibits plant growth (Filho and Paiva, 2006).

The life cycle of scale insects is similar. Males and females have a different life cycle. The male undergoes six stages: eggs, first-instar nymphs, second-instar nymphs, pre-pupae, pupae, and adults while the female undergoes five stages: egg, first-instar nymph, second-instar nymph, third-instar nymph, and adult (Kakoti et al., 2022). Pseudococcidae and Coccidae become destructive pests in the nymph and adult stages (Puspitasari et al., 2023).

The other families have beneficial roles in ecology. Muscidae is a family commonly known by the public in the form of flies. Muscidae have an important role in the ecosystem where one of

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the important roles is as a pollinator for plants (Kwak et al., 2006). However, Muscidae is parasites while in the larva stage and parasitic for human and animal (Lucius et al., 2017). Formicidae, known as the ants family, is one of the eusocial insect groups that have the highest abundance and is cosmopolitan (Coleman and Wall, 2015). The Formicidae family is either a predator or an eater of soil organic matter. Some of the roles of these organisms are as decomposers, pollinators, soil aerators, pests, and predators. Because Formicidae found in this observation was relatively small, it role was classified as pollinating organisms (Abtar et al., 2013). Chironomidae is known as non-biting midges (Karima, 2020). The ecology roles of Chironomidae are micro detritivores and prey for invertebrates. This family also becomes an environmental pollution bioindicator (Farhani et al., 2014).

Abiotic factors influenced the arrival of arthropods to Aglaonema (Table 1). Most of the arthropods visited Aglaonema in the morning totaling 102 individuals in the first week with the most numerous families being Coccidae. Arthropods have a biological clock. This causes arthropods to determine the time to rest and do activities. With a biological clock, Arthropods can be doing activity intensively and optimally (Muhibah and Leksono, 2015). This is related to the visiting parasites decreasing during the day. Insects have a minimum, optimum, and maximum temperature for survival. These are 15°C for minimum temperature, 25°C for optimum temperature, and 45°C for maximum temperature. Insects cannot filter light into the compound eye system so insects stay away from light at close range (Muhibah and Leksono, 2015).

Arthropods visit Aglaonema most often in sunny weather (Table 1). It was recorded that cloudy weather occurred twice, the first week in the afternoon and the third week in the morning. Arthropods that visited during cloudy weather only one individual in the first week and no arthropods visit in the third week. Weather is related to the sunlight intensity. Light intensity affects arthropod life. The benefit of sunlight is as a marker for arthropods for certain activities. These activities include foraging and reproduction (Ardillah et al., 2014).

Table 1. Abiotic factors recorded during observations

Week	Time	Total Arthropod Density	Temperature (ºC)	Humidity (%)	Weather
1	Morning	102	25	81	Sunny
	Noon	0	28	80	Sunny
	Afternoon	1	23	83	Cloudy
2	Morning	0	24	82	Sunny
	Noon	8	29	70	Sunny
	Afternoon	0	26	85	Sunny
3	Morning	0	22	90	Cloudy
	Noon	1	29	71	Sunny
	Afternoon	0	24	85	Sunny

The arthropod community structure was indicated by the Importance Value Index (IVI). Each week of observation had a family with a different dominant IVI. The dominant arthropod was Coccidae in the first week, Formicidae in the second week, and Chironomidae in the third week (Figure 2). In the second and third weeks, only one Arthropod family was observed.

Arthropods diversity was only seen in the first week of observation with four families. The diversity index value in the first week for each family was 0.04 in the Coccidae family and 0.06 in the Pseudococcidae, Muscidae, and Formicidae families. There was no diversity index value in the second and third weeks of observation because only one family was observed (Figure 3).

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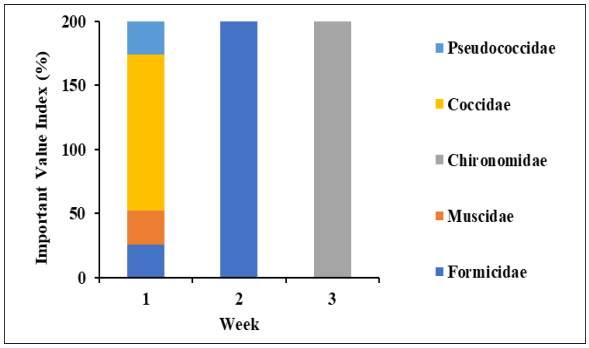

Figure 2. Important Value Index (IVI) of Arthropods found in Aglaonema

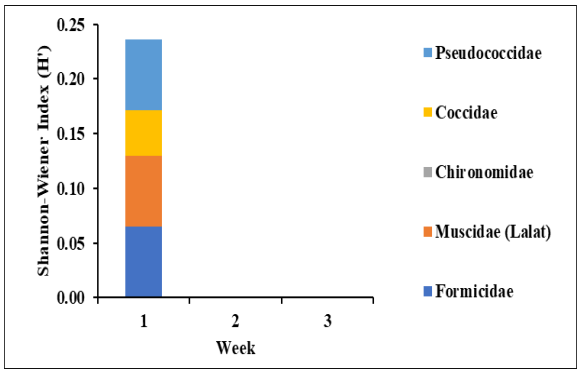

Figure 3. Shannon-Wiener Index (H') of Arthropods found in Aglaonema

The Way to Overcome Arthropods

There are several ways to deal with ectoparasites on Aglaonema. Aglaonema infected or attacked by ectoparasites can be moved or placed far from the other healthy Aglaonema so that the percentage of ectoparasites attacking healthy Aglaonema are smaller. Another solution is removing the parts of Aglaonema that are still not severely infected and can also be sprayed with pesticides to kill insects around Aglaonema. However, the usage of pesticides is inefficient because some ectoparasites, such as Pseudococcidae, are located in parts of plants that are not exposed to pesticides, thus requiring plant owners to be more careful and more consumed in the use of pesticides. Another solution that is more natural and widely developed is to take advantage of the presence of natural enemies or predators for ectoparasites which can be general (generalist) or specific (specialist) (Hajek, 2004). Natural enemies or predators of ectoparasites will live in a suitable environment such as certain plants that support the life of natural enemies of ectoparasites, which generally these specific plants are categorized as refugia plants. Refugia plants generally do not interfere with the existence of target plants attacked by ectoparasites and the types of natural enemies that can be focused on are generalist groups because these types of natural enemies will prey on the presence of ectoparasites regardless of the specifications of the type of ectoparasites that attack the target plants (Malan and Hatting, 2015 ; Rakhshani and Stary, 2021).

CONCLUSION

Five types of arthropods have been found in Aglaonema including Coccidae, Pseudococcidae, Muscidae, Chironomidae and Formicidae in which the Pseudococcidae and Coccidae families are types of arthropods that are ectoparasites to plants in general. Those families only observed in the first week. The IVI value of Coccidae was 122.09% while the H' value was 0.04. The IVI value of Pseudococcidae was 25.97% while the H' value was 0.06. The effect of ectoparasites in Aglaonema is sucking the sap of plant which disrupts the physiological condition of the plant and secrete honeydew that cause soot mold to grow thus causes damage to the plant. Ectoparasites in Aglaonema can be overcome, including removing infected plants from healthy plants, removing infected plant parts, and/or placing refugia plants in the habitat of natural enemies of ectoparasites.

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