Symptoms and Infestation Levels of the Emerging Coffee Leaf Miner Pest in Bandung Regency

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Abstract

The coffee leaf miner is an emerging threat to coffee cultivation in Bandung, West Java. Despite its potential impact, there is a significant knowledge gap regarding the identity and ecology of leaf-mining insect species affecting coffee plants in this region. To address this issue, a research initiative was conducted to document the occurrence, distribution, and impact of leaf miners in coffee plantations within Bandung Regency. The objectives of the study were to characterize the symptoms of infestation and quantify the extent of foliar damage under field conditions. Study sites were selected through purposive sampling, based on reports from local coffee farmers regarding suspected leaf miner activity. Damage intensity was assessed using a standardized scoring system, while damage severity was quantified using a systematic diagonal sampling method. The survey confirmed the presence of leaf miners belonging to the family Gracillariidae (Lepidoptera), representing the first recorded incidence of this group affecting coffee crops in the Bandung region. All coffee plants surveyed in the study plots exhibited signs of infestation, with the maximum recorded mean damage severity reaching 25% leaf area loss. These findings enhance the understanding of leaf miner pest dynamics in Indonesian coffee agroecosystems and offer a valuable reference for the development of targeted monitoring systems and integrated pest management (IPM) strategies.

Keywords: Damage severity; Gracillariidae; leaf miner

Introduction

Coffee is one of the key plantation commodities with high economic value and plays an important role in increasing farmers' income and driving economic growth in producing regions. Bandung Regency, located in West Java province, plays a vital role as a hub for coffee production in the region. The vast coffee plantations covering 13.528 hectares in Bandung Regency contribute to a yield of 7.825 metric tons, as reported by (BPS JABAR 2022). However, the productivity and quality of coffee yields face various challenges, particularly from pest infestations, which can cause significant economic losses if not properly managed.

One emerging pest in the Bandung area is the coffee leaf miner, which may also have spread to several coffee-producing areas in Indonesia. Despite being classified as a secondary pest, its presence can significantly disrupt plant growth and interfere with the development of coffee fruits. The coffee leaf miner is known to cause considerable damage to coffee plantations in Brazil and other Neotropical regions by consuming coffee leaves' chlorophyll-rich parenchyma palisade tissue, essential for photosynthesis (Dantas et al., 2021). Several species of coffee leaf miners have been reported. While research on coffee leaf miner infestations has been conducted in countries such as Brazil

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and Mexico, a comprehensive report on coffee leaf miners in Indonesia is currently very limited.

A preliminary report on coffee leaf miners and their parasitoids in Probolinggo Regency, East Java, has been published (Shaleh, 2023). Nevertheless, specific knowledge regarding the species involved and the damage inflicted remains insufficient. To address this gap, the present study was conducted to observe and document the symptoms and damage associated with coffee leaf miner infestations in Bandung Regency. By characterizing infestation patterns and quantifying foliar damage, this research contributes to a deeper understanding of pest dynamics in Indonesian coffee systems and offers a basis of information for the development of effective monitoring and IPM strategies.

Research Method

Study Site:
Leaf mine samples were collected from coffee plantations in the Mount Puntang region, Bandung Regency, West Java, Indonesia (7°06'59.5"S 107°36'17.5"E, 1300 m above sea level) in September and November 2023. The locations were identified based on reports from local coffee farmers regarding suspected leaf miner activity. Sample collection and observation of damage intensity were conducted as part of this research.

Collecting Samples:
Coffee leaf miner specimens were collected through purposive sampling by selecting coffee leaves with visible symptoms of infestation, especially targeting young leaves. The infested leaves were placed into plastic boxes (16 cm × 16 cm × 6 cm), properly labeled with collection details, and transported to the Insect Biosystematics Laboratory, IPB University, Bogor, Indonesia. The leaf mines, larvae, pupae, and adult coffee leaf miners were observed during the rearing process. The remaining leaves were reared under controlled laboratory conditions to obtain adult specimens. Specimen identification utilized the insect identification key from *The Insects of Australia* (CSIRO, 1991).

Damage Severity:
The severity of coffee leaf miner infestation in Bandung Regency was assessed using the systematic diagonal sampling method. Five observation subplots were selected diagonally in the study area, with each subplot consisting of five coffee plants showing signs of leaf miner infestation. All leaves on each plant were examined and classified into five scoring categories based on the level of visually estimated mined area damage, as follows:

- Score 0 (0% damage)
- Score 1 (<25% mined area)
- Score 2 (25-50% mined area)
- Score 3 (50-75% mined area)
- Score 4 (>75% mined area)

Data were collected in the form of a leaf count distribution based on the severity scores, and severity was calculated using the average score per subplot.

Analysis Data:

The average severity score was calculated for each subplot. The scoring results were then used to analyze the severity distribution based on the scoring categories. This study takes an observational descriptive approach to show the variation and distribution of leaf severity at each score level. Data presented in a boxplot was conducted using RStudio version 2023.09.1+494, integrated with R version 4.3.2.

Results and Discussion

Site Collection Description

The research was carried out in coffee-growing areas within the Mount Puntang region of Bandung Regency, West Java, Indonesia. The site lies at an elevation of 1370 meters above sea level and belongs to a tropical highland agroecosystem characterized by relatively cool temperatures and high annual rainfall. The coffee plants observed were Arabica, aged around 3-5 years, and cultivated under natural shade provided by pine trees (*Pinus* spp.) (Figure 1). The plantation is supported by fertile, well-drained volcanic soils, which are typical of the region and favorable for coffee growth.

The research site was selected based on field interviews with coffee farmers. Although several coffee plantations in Bandung Regency were previously found to show signs of coffee leaf miner infestation, survey and interview results indicated that the chosen location had the highest level of infestation compared to the others. Observations were carried out during the months of September and November, coinciding with the transitional period between the dry and rainy seasons. At the time of sampling, rainfall had already begun, indicating the early phase of the rainy season.

Figure 1. Site collection sample condition

Symptoms of Coffee Leaf Miner

In this study, we observed the symptoms of leaf miner infestation belonging to the Family Gracillariidae (Lepidoptera). Gracillariidae is one of the most diverse families within the microlepidoptera, known primarily for the leaf-mining behavior exhibited during the larval stage. This family consists of approximately 166 genera and over 2,000 species distributed worldwide (De Prins & De Prins 2024). Characterized by

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an endophagous feeding habit, most larvae are leaf miners; however, certain species have adapted to mining stems or fruits, while others act as flower or fruit borers, leaf rollers, or gall inducers (Brito et al. 2016).

Figure 2. Symptoms of coffee leaf miner from Bandung Regency. Larva gracilariid mining on young leaf (A), Leaf miner symptoms on old leaf (B).

Symptoms of the coffee leaf miner manifest as visible traces of leaf-mining on the upper surface of the leaves. The resulting mines exhibit a narrow, linear, long, transparent winding pattern. The size of the mines increases with the larval instar phase, as older larvae require more food than younger instars. Leaf miner larvae consume leaf tissue, leaving only the upper epidermis (Figure 2A). No mining symptoms are evident on the lower leaf surface. In severe cases, the mines may cover the entire upper leaf surface. The larvae, actively feeding, primarily target relatively young leaves and are commonly found at the tips of plant branches. This preference may be attributed to the smoother surface and softer texture of young leaves, facilitating the larvae in creating mines for their survival. Additionally, young leaves provide sufficient nutrients for larval development. There is no larval feeding activity on older leaves, so the mines dry up and turn brown (Figure 2B).

In the final instar larval stage, larvae cease feeding and prepare to pupate. The pupation occurs on cocoon that folded on the edge of the leaves. Adults are characterized by their small size, with body length less than 20 mm. The species exhibits filiform antennae that extend beyond the length of the forewings, alongside a notably elongated and rolled proboscis. Larvae are phytophagous, exhibiting a characteristic leaf-mining behavior on host plants. Pupation typically occurs within a silk-lined chamber constructed at the distal margin of the mined area, where the leaf edge is folded to provide a protective enclosure (CSIRO 1991).

Shaleh (2023) previously reported that the coffee leaf miner *Leucoptera coffeella* (Guérin-Méneville) (Lepidoptera: Lyonetiidae) was found in Probolinggo Regency, East Java. Coffee leaf miner *Leucoptera coffeella* (Guérin-Méneville) (Lepidoptera: Lyonetiidae) also known as a primary pest in South America, causing

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extensive defoliation in coffee plants (Fanela *et al*. 2020; Dantas *et al*., 2021). The larvae of *L. coffeella* penetrate coffee leaves, leading to surface injuries and necrotic lesions, ultimately impacting plant photosynthesis, productivity, and longevity (Fanela *et al*. 2020). This effect can be particularly detrimental to more vulnerable coffee genotypes, such as *Coffea arabica*, causing significant defoliation. The manifestations of this pest infestation include mines that transition from a light green color to brown, corresponding to the larva's development and its movement to new feeding sites (Motta *et al*. 2021).

However, it differs from what we found in Bandung Regency. The symptoms of coffee leaf miners observed in Bandung Regency differ significantly from those reported for *L. coffeella* in Brazil. *L. coffeella* typically causes brown leaf spot symptoms due to larval feeding activities, resulting in large necrotic areas under severe damage (Figure 3B). In contrast, the symptoms observed in this study involve transparent tunnels with winding paths without the presence of brown leaf spots (Figure 3A). Similarly, observations of larvae to imago during the maintenance period showed that the characteristics of the larvae and imago observed differ from those of *L. coffella*. Therefore, the leaf miner species found on this coffee plant is not *L. coffella*. The leaf miner species found in Bandung Regency has been classified under the family *Gracillariidae*, and this marks the first documented case of its infestation on coffee plants in the region.
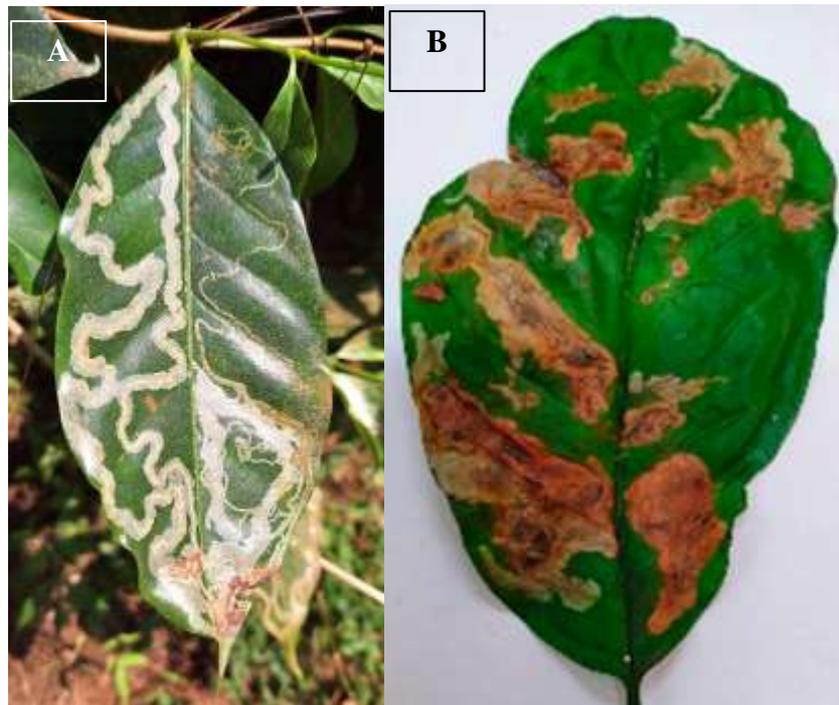

Figure 3. Symptoms of leaf miner for comparision. Coffee leaf mines by gracillariid in Bandung Regency (A), coffee leaf miner Leucoptera coffella in Brazil (Dantas et al. 2021) (B).

Damage Severity of Coffee Leaf Miner

Field observations of leaf miner infestation in coffee were conducted on a 0.5-hectare plantation plot. In the observed plot, a total of 507 coffee plants were recorded, all of which showed typical symptoms of leaf mining, indicating a complete (100%)

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infestation across the area. Nevertheless, despite the high incidence, the severity of damage observed on individual plants was relatively low. Leaf damage was divided into five categories based on the estimated percentage of symptoms coffee leaf miner infestation, as shown on Figure 4.

The boxplot analysis of the average percentage of leaf damage in each category indicates that most of the observed coffee leaves remain in a healthy condition, with severity category 0 dominating the average at 55% (Figure 5). Severity category 1 (foliage damage ±25%) ranks second, with an average of approximately 25%. In contrast, severity categories 2, 3, and 4 show progressively lower average percentages (below 10%) as the level of damage increases. This pattern reveals a decreasing trend in the number of damaged leaves as severity increases, suggesting that most of the infestations observed in the field are at low severity levels or have not yet caused significant damage.

Figure 4. Severity categories based on symptoms of coffee leaf miner infestation. Damage scores were categorized as follows: 0 = no damage, 1 = <25% mined area, 2 = 25-50% mined area, 3 = 50-75% mined area, 4 = >75% mined area.

Findings like this are strongly influenced by the resistance of the host plant, environmental conditions, or the presence of effective natural enemies, which often play a role in limiting the progression of damage to more severe stages. Various factors, such as cultivars, farming practices, climate, altitude, seasonal changes, unregulated use of phytosanitary products, and the presence of adventitious and associated plants, among others, affect the damage caused by coffee leaf miner larvae (Dantas *et al*. 2021). As observed in this study, the sampling of symptomatic leaves during the rainy season revealed fewer symptomatic young leaves, suggesting that different results might be obtained if the sampling were conducted during the dry season. The severity of coffee leaf miner attacks is usually more noticeable during dry periods, influenced by factors such as temperature, relative humidity, and rainfall (Dantas *et al*. 2021). Therefore, continuous monitoring is crucial to detect shifts in severity trends, especially during different seasons or with changing management practices

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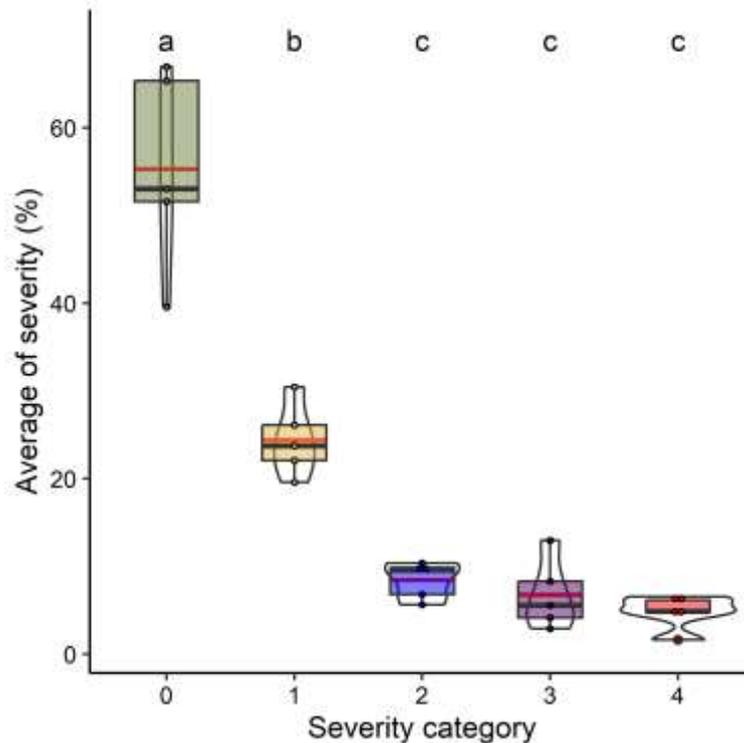Indonesia

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Figure 5. Percentage of score categories of coffee leaf-mining symptoms in Mount Puntang, Bandung. Samples consisted of five plants per sub-plot. Damage scores were categorized as follows: 0 = no damage, 1 = <25% mined area, 2 = 25-50% mined area, 3 = 50-75% mined area.

Conclusion

This survey documented the presence of leaf miners from Bandung Regency belonging to famili Gracillariidae (Lepidoptera) with symptoms are visible on the upper leaf surface as narrow, linear, and transparent winding mines formed by the larvae. This marks an initial report of their infestation in coffee plantations within the Bandung area. The study found that most coffee leaves remained healthy, with severity category 0 (no damage) accounting for 55% of the samples, followed by category 1 (25% mined area). This suggests that the coffee leaf miner infestation in the study area is generally at a low severity level, with minimal impact on overall leaf health.

The findings highlight the importance of continued monitoring to detect changes in severity levels, particularly across different seasons, and to evaluate the effectiveness of management practices. Additionally, further identification and study of the coffee leaf miner is needed to better understand its life cycle and attack patterns, which will support the development of more effective pest management strategies

References

De Prins and De Prints (2024). Global Taxonomic Database of Gracillariidae (Lepidoptera), *World Wide Web electronic publication* (http://www.gracillariidae.net) (Accessed 2025 April).

Brito, R., De Prins, J., De Prins, W., Mielkec, O.H.H., Goncalves, G.L.¸ Moreira, G.R.P. (2016). Extant diversity and estimated number of Gracillariidae (Lepidoptera) species yet to be discovered in the Neotropical region. *Revista Brasileira de Entomologia,* 60, 275–283.

[BPS JABAR] Badan Pusat Statistik JAWA BARAT. (2022). Produksi Tanaman Kopi (Ton), 2019-2021.[Accessed 2023 Agu 14]. https://jabar.bps.go.id/indicator/163/319/1/produksi-tanaman-kopi-.html

CSIRO. (1991). *The Insects of Australia: A textbook for students and research workers* (2nd ed.). Melbourne University Press, (p. 817-854).

Dantas, J., Motta, I.O., Vidal, L.A., Eliza, F.M.B.N., Bilio, J., Pupe, J.M., Veiga, A., Carvalho, C., Lopes, R., Rocha, T.L., Silva, L.P., Pujol-Luz, J.R., Albuquerque, E.V.S. (2021). A comprehensive review of the coffee leaf miner *Leucoptera coffeella* (Lepidoptera: Lyonetiidae)—A major pest for the coffee crop in Brazil and others Neotropical Countries. *Insects*, 12(12): 2. doi: 10.3390/insects12121130

Fanela, T.L.M., Baldin, E.L.L., Bentivenha, J.P.F., Santana, A.D. (2020). Assessing potential plants extracts to reduce *Leucoptera coffeella* (Lepidoptera: Lyonetiidae) attack in coffee. *Coffee Science*, e151653.

Motta, I., Dantas, J., Vidal, L., Bilio, J., Pujol-Luz, J. R., & Albuquerque, É. V. (2020). From basic to applied knowledge: Larval development and sex morphology to control *Leucoptera coffeella* (Lepidoptera: Lyonetiidae). *Embrapa genetic resources & Biotechnology*, 1(1): 1 – 19.

Shaleh, A.R. (2023). Inventarisasi hama pengorok daun kopi arabika (*Coffea arabica*) serta parasitoidnya di Desa Bremi dan Desa Watu Panjang Kabupaten Probolinggo [thesis]. Jember: UNEJ.