



Community Structure and Spatial Distribution of Mealybugs on Cassava Plants in Bali, Indonesia

Made Mika Mega Astuthi^{1)*}, Dicky Marsadi²⁾, I Wayan Dirgayana¹⁾

¹⁾ Agrotechnology Study Program, Faculty of Agriculture and Bussiness, Universitas Dwijendra, Bali, Indonesia

²⁾ Agrotechnology Study Program, Faculty of Agriculture, Universitas Udayana, Bali, Indonesia

*E-mail: made.mika90@gmail.com

Received: 25 September 2025

1st Revised: 30 November 2025

Accepted: 26 December 2025

Published: 31 December 2025

Abstract

Mealybugs (Hemiptera: Pseudococcidae) are important pests that threaten cassava in Bali; however, detailed information on their community structure and spatial distribution remains limited. This study aimed to analyze the community structure and spatial distribution patterns of mealybugs infesting cassava across Bali Province, Indonesia. Field sampling was conducted in nine regencies—Jembrana, Tabanan, Buleleng, Badung, Denpasar, Gianyar, Bangli, Klungkung, and Karangasem—using a diagonal sampling method. In each regency, five sampling units were established, with five cassava plants observed per unit. On each plant, three upper, middle, and lower leaves were examined. The results of the study showed four mealybug species: *Phenacoccus manihoti*, *Paracoccus marginatus*, *Ferrisia virgata*, and *Pseudococcus jackbeardsleyi*, with species richness index values ranging from 0.368 to 0.388. All species were recorded in all surveyed regencies and exhibited a predominantly random spatial distribution pattern, as indicated by a variance-to-mean ratio ($S^2/X \approx 1$). Overall dominance was highest for *P. marginatus* (46.23%), particularly in Karangasem, followed by *P. manihoti* (45.72%) in Denpasar. The mealybug community structure was characterized by a diversity index (H') ranging from 0.73 to 1.22, an evenness index (E) ranging from 0.16 to 0.24, and a dominance index (C) ranging from 0.32 to 0.54, indicating spatially variable communities that ranged from relatively stable to less stable conditions. These findings provide the baseline data on the community structure and spatial distribution of mealybugs on cassava in Bali, offering important insights for developing targeted monitoring and sustainable pest management strategies.

Keywords: Composition, diversity, dominance, *Paracoccus marginatus*, Pseudococcidae

Introduction

Cassava (*Manihot esculenta*) is one of the agricultural commodities prioritized in the Indonesian government's "Prestige Cassava" program, which aims to strengthen national food security through food diversification strategies (Setiawan and Sebayang, 2022). This prioritization is driven by cassava's

multifunctional role as a significant source of carbohydrates (Noerwijati and Mejaya, 2015), an important raw material for agro-industries, and a non-oil export commodity (Pramesty et al., 2017). Nowadays, cassava productivity remains highly vulnerable to insect pest infestations, particularly those caused by mealybugs (Hemiptera: Pseudococcidae).

Mealybugs are among the most destructive pests of cassava, capable of causing substantial yield losses ranging from 30% to 50% under severe infestations (Wardani, 2015). Their damage results from direct sap feeding, toxin injection, and indirect effects such as honeydew deposition, which promotes sooty mold growth and reduces photosynthetic efficiency. Consequently, mealybugs are considered key limiting factors in cassava production systems in Indonesia.

Globally, a high diversity of mealybug species has been reported attacking cassava (Widyantoro and Badiatul, 2024). William and Granara de Willink (1992) documented at least 19 mealybug species associated with cassava in South America. In Indonesia, several species are commonly reported, including *Paracoccus marginatus*, *Ferrisia virgata*, *Pseudococcus jackbeardsleyi*, and *Phenacoccus manihoti* (Lovalini, 2016; Nurmasari, 2015; Zarkani et al., 2023). The coexistence and relative dominance of these species can substantially influence the severity of infestations and determine the effectiveness of pest management interventions (Andini et al., 2025; Hidrayani et al., 2019).

Various control measures have been implemented to manage mealybug infestations, including mechanical control and the application of insecticides (Sajar et al., 2024). However, the success and sustainability of these approaches depend strongly on a comprehensive understanding of mealybug bioecology, particularly their community structure within cassava agroecosystems. Community structure, which encompasses species composition, relative abundance, dominance patterns, and spatial distribution, represents a fundamental ecological parameter for designing effective and environmentally sound integrated pest

management (IPM) strategies (Srinurningsih et al., 2023; Suparno et al., 2018).

Nowadays, detailed information on the community structure and spatial distribution of mealybug populations on cassava plants in Bali Province remains unavailable. Existing studies in Bali have predominantly focused on a single species, *P. manihoti* (Yudha et al., 2020; Supartha et al., 2022), while investigations involving multiple mealybug species have been limited to a single regency (Marsadi et al., 2023). As a result, a substantial knowledge gap persists regarding the comprehensive characterization of mealybug communities across Bali's cassava-growing regions. This gap is particularly critical given the island's heterogeneous landscapes, which may influence pest assemblages and infestation dynamics.

Therefore, this study adopts a province-wide approach encompassing all major cassava-producing areas in Bali and all mealybug species associated with cassava plants. The objectives of this study were to determine community structure and spatial distribution on mealybugs across cassava agroecosystems in Bali Province. The results of this study were to provide essential baseline information to support the development of targeted monitoring programs and sustainable management strategies for mealybugs in cassava.

Methods

This research was conducted in cassava fields owned by farmers in Bali. Sampling of mealybugs was carried out in Jembrana, Tabanan, Buleleng, Badung, Denpasar, Gianyar, Bangli, Klungkung, and Karangasem Regencies from June 2025 to September 2025 (Table 1). The study sites were selected to represent the major cassava-growing agroecosystems across Bali Province (Figure 2).

Table 1. Geographic locations of mealybug sampling sites in Bali Provinc

Regency	Location (Village)	Altitude (m asl)
Bangli	Susut	445 m
	Tembuku	28 m
	Bunutin	237 m
	Songan	532 m
	Batukaang	927 m
Tabanan	Selemadeg	58 m
	Kediri	95 m
	Kerambitan	184 m
	Baturiti	622 m
	Pupuan	738 m
Badung	Canggu	29 m
	Munggu	76 m
	Sangreh	283 m
	Plaga	973
	Petang	622
Gianyar	Kenderan	450 m
	Ubud	146 m
	Payangan	503 m
	Temesi	52 m
	Petak Kaja	466 m
Klungkung	Banjarangkan	510 m
	Nyalian	323 m
Denpasar	Aan	241 m
	Selat	207 m
	Kusamba	20 m
	Pegok	12 m
	Renon	22 m
Jembrana	Tembau	84 m
	Sanur	10 m
	Peguyangan	77 m
	Pala sari	38 m
	Melaya	28 m
Karangasem	Jembrana	26 m
	Mendoyo	15 m
	Pekutatan	9 m
	Manggis	19 m
	Seraya	43 m
Buleleng	Bebandem	343 m
	culik	41 m
	Tianyar	11 m
	Tejakula	375 m
	Sawan	69 m
Buleleng	Buleleng	37 m
	Grogak	17 m
Buleleng	Busungbiu	281 m

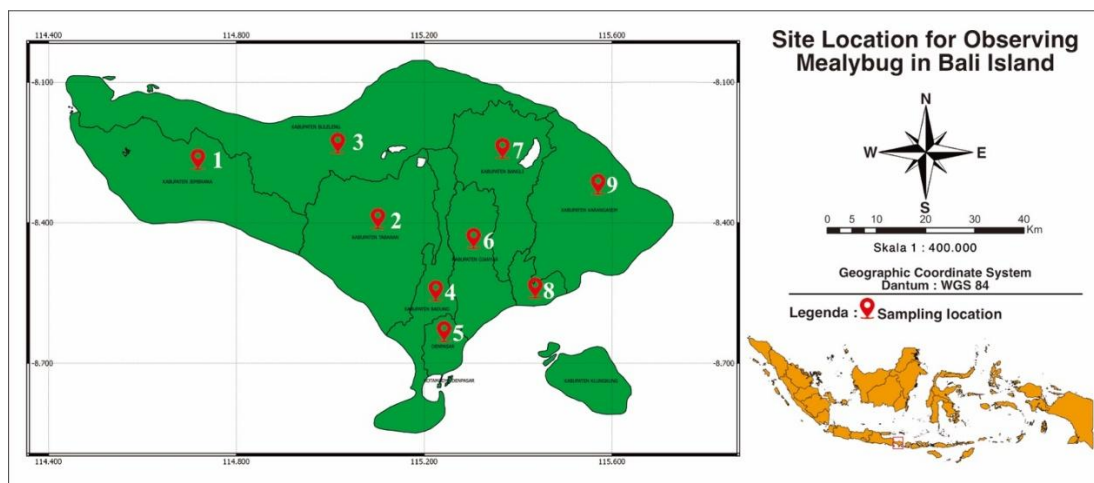


Figure 1. Locations for mealybugs sampling in several regency on the island of Bali, Indonesia. 1. Jembrana, 2. Tabanan, 3. Buleleng, 4. Badung, 5. Denpasar, 6. Gianyar, 7. Bangli, 8. Klungkung, 9. Karangasem.

Methods

This study was conducted using a field survey method to investigate the community structure of mealybugs associated with cassava in Bali, by sampling cassava leaves infested with mealybugs from farmers' cassava fields across the study area.

Research Procedure

In each regency, research locations were determined using a diagonal sampling

approach to ensure representative coverage of each field. Within each location, sampling units were established, and five cassava plants were selected purposively in each sampling unit based on the presence of mealybug infestation, following the methods described by Pangestu (2017) and Wahyuni et al. (2017). Observations were carried out on each selected plant by collecting leaves from three vertical strata, namely upper leaves, middle leaves, and lower leaves (Figure 2).

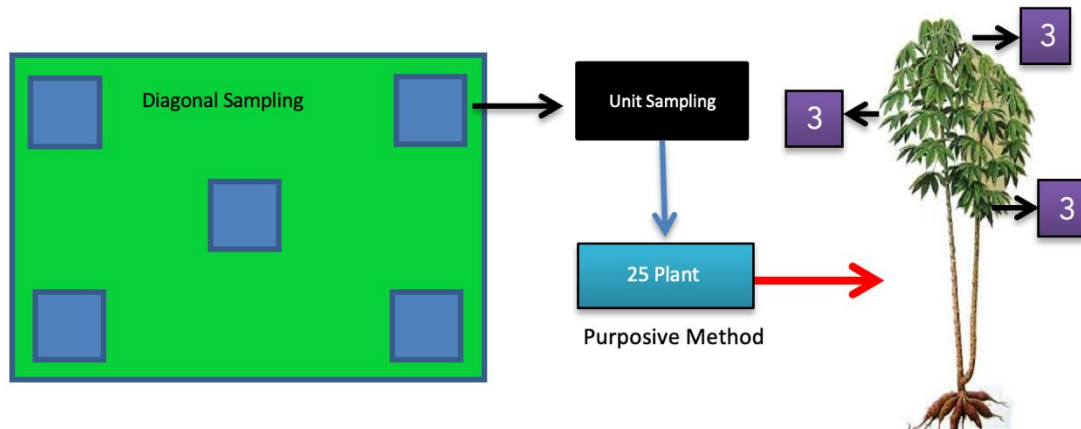


Figure 2. Schematic illustration of cassava plant sampling showing vertical leaf strata (upper, middle, and lower leaves) used for mealybug collection

This stratified leaf sampling was applied to capture the vertical distribution of mealybugs within the plant canopy. A total of 225 cassava plants were observed across Bali Province. Sampling was conducted once at each location during the study period. All collected leaf samples were placed in labeled plastic bags indicating the sampling location and altitude, and then transported to the laboratory for further analysis. In the laboratory, mealybugs were examined and identified to species level to determine community structure parameters, including species composition, abundance, diversity, and dominance. Species identification was carried out using the morphological identification keys developed by Williams and Granara de Willink (1992).

Variable Observed and Data Analysis

To describe composition, community structure, species richness, and spatial distribution of mealybugs associated with cassava plants, several parameters were quantified.

Species composition was expressed as the relative abundance of each mealybug species, calculated as the proportion of individuals of a given species relative to the total number of individuals collected. Type composition used Odum's formula (1996):

$$P_i = \frac{n_i}{N} \times 100 \dots\dots\dots (1)$$

Description: P_i = type composition, n_i = number of i -th type, N = total number

Species richness index using the Margalef Index (Magurran, 2004):

$$D_{mg} = \frac{(S-1)}{\ln(N)} \dots\dots\dots (2)$$

Description: D_{mg} = species richness index, S = number of types, N = total number of all species Index value: $< 2,5$ = bad kind of wealth, $2,5-4,0$ = moderate wealth, $> 4,0$ = good species wealth

Community structure is an ecological concept that describes the organization of species within a community, encompassing species composition, diversity, evenness, and dominance (Solihin et al., 2024). Community structure was evaluated using standard diversity, evenness, and dominance indices.

Shannon-Wiener diversity index (Magurran, 2004) :

$$H' = - \sum P_i \ln P_i \longrightarrow p_i = n_i/N \dots\dots\dots (3)$$

Information: H' = diversity index, $P_i = n_i/N$ (number of individuals of type i divided by the total number of individuals), n_i = number of individuals of type i , N = total number of individuals

Index value: $< 1,5$ = low diversity index, $1,5-3,5$ = moderate diversity index, $> 3,5$ = high diversity index

The dominance index is calculated using the Menhinick index (Magurran, 2004):

$$C = \sum \frac{n_i(n_i-1)}{N(N-1)} \dots\dots\dots (4)$$

Description: C = indeks dominansi, N = jumlah total individu, N_i = jumlah individu jenis ke- i
 Nilai: $0,00 < D < 0,30$ = indeks dominansi rendah, $0,30 < D < 0,60$ = indeks dominansi sedang, $0,60 < D < 1,00$ = indeks dominansi tinggi

Evenness equality index (Oddun, 1996):

$$E = \frac{H}{H_{max}} \dots\dots\dots (5)$$

Description: E = equality index ($0 - 1$), H = Shannon-Wiener diversity index, H_{max} =

maximum diversity index = $\ln S$, where S = number of types (species) in the community.

E value criteria: $E > 0,6$ = high species evenness, $0,60 \geq E \geq 0,4$ = moderate species evenness, $E < 0,4$ = low species evenness

Spatial distribution was determined using the variance-to-mean ratio, calculated from mealybug counts per sampling unit to classify distribution patterns as random, uniform, or aggregated. The formula from Fowler and Cohen's distribution pattern (Badriasih et al., 2019):

$$S^2 = \frac{\sum (X_i - \bar{X})^2}{n-1} \dots\dots\dots (6)$$

Description: S^2 = variance, X_i = X to- i , $\bar{X}$ = X average, n = total sampling

Criteria: $S^2/\bar{X} < 1$ = regular distribution pattern, $S^2/\bar{X} = 1$ = random distribution pattern, $S^2/\bar{X} > 1$ = clustered distribution pattern.

Results

Species Composition

The species composition of mealybugs in each regency in Bali is presented in Figure 3, while the overall composition across all observation areas is shown in Figure 4. Identification of mealybugs collected from nine regencies revealed the presence of four species, namely *Phenacoccus manihoti*, *Paracoccus marginatus*, *Ferrisia virgata*, and *Pseudococcus jackbeardsleyi*. Overall, *P. marginatus* and *P. manihoti* were the two dominant species across most observation sites. *P. marginatus* exhibited the highest relative abundance in Karangasem, meanwhile *P. manihoti* in Denpasar. The other two species, *F. virgata* and *P. jackbeardsleyi*, occurred at consistently low proportions ($<10\%$) across all study locations (Figure 3, Figure 4, Figure 5).

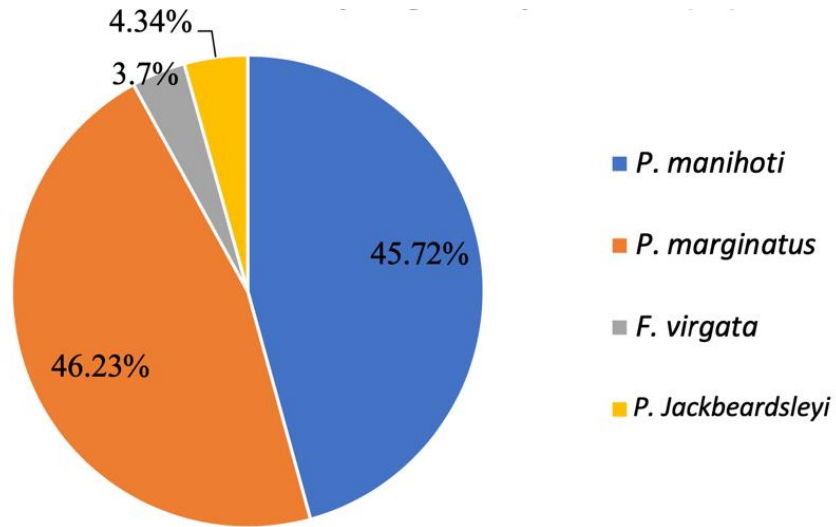


Figure 3. Overall species composition of mealybugs infesting cassava in Bali, Indonesia

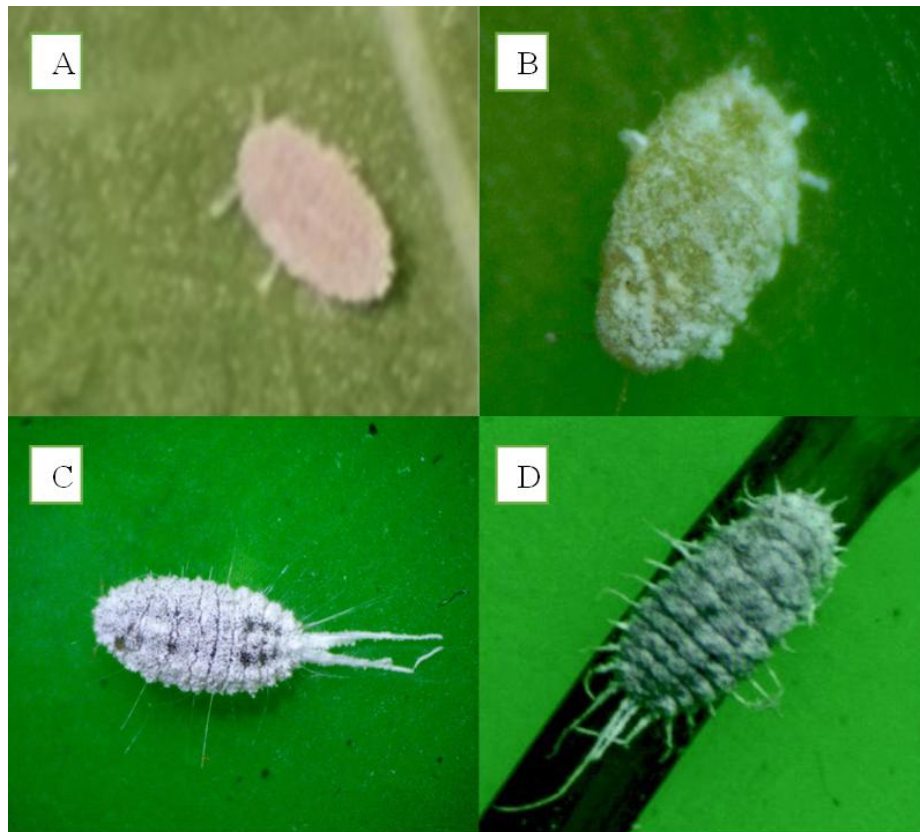


Figure 4. (A) *Phenacoccus manihoti*, (B) *Paracoccus marginatus*, (C) *Ferrisia virgata* (D) *Pseudococcus jackbeardsleyi*

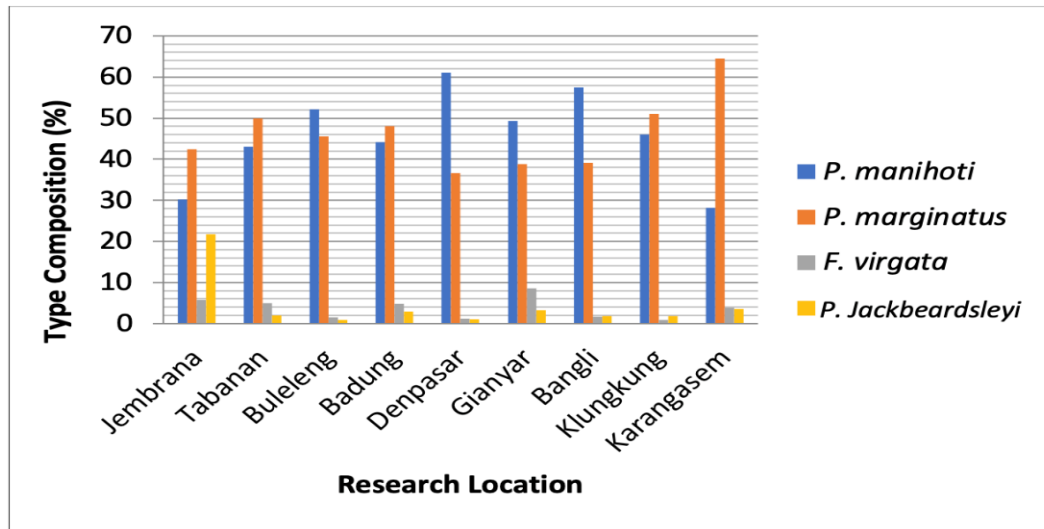


Figure 5. Species composition of mealybugs infesting cassava across nine regencies in Bali, Indonesia

Species Richness Index

The species richness index calculated using the Margalef index (Dmg) at the nine research sites in Bali showed relatively uniform. The number of mealybug species recorded at all observation sites was four species. Nevertheless, the total number of individuals differed among locations, ranging

from 2,264 to 3,496 individuals. As a result, the Margalef species richness index (Dmg) varied only slightly among sites, with values ranging from 0.368 to 0.388. The highest Dmg value was recorded in Buleleng (0.388), while the lowest value was observed in Bangli (0.368) (Table 2).

Table 2. Species richness of mealybugs infesting cassava in Bali (Margalef index (Dmg)).

location	Σ species	Σ Number of individuals	Dmg
Jembrana	4	2,338	0.387
Tabanan	4	2,490	0.384
Buleleng	4	2,264	0.388
Badung	4	2,841	0.377
Denpasar	4	3,048	0.374
Gianyar	4	2,893	0.376
Bangli	4	3,496	0.368
Klungkung	4	2,476	0.384
Karangasem	4	2,741	0.379

Community Structure

The Shannon–Wiener diversity index (H') ranged from 0.66 to 1.22 (Badung to Jembrana). The evenness index (E) varied from 0.12 in Gianyar to 0.24 in Jembrana, while the dominance index (C) ranged from 0.32 to 0.54 (Jembrana to Bangli. In general,

regencies with higher H' values, such as Jembrana and Tabanan, tended to exhibit higher evenness and lower dominance values. This pattern indicates that mealybug communities in these areas were characterized by a more balanced species distribution (Table 3).

Table 3. Diversity, evenness, and dominance indices of mealybugs in Bali

Types of Mealybugs	Number of Individuals in Each Regency. -								
	1	2	3	4	5	6	7	8	9
Total (N)	2,338	2,490	2,264	2,841	3,048	2,893	3,496	2,476	2,741
Diversity (H')	1.22	0.94	0.80	0.96	0.77	1.04	0.73	0.82	0.88
Evenness (E)	0.24	0.21	0.19	0.21	0.16	0.22	0.16	0.19	0.20
Dominance (C)	0.32	0.44	0.48	0.43	0.51	0.40	0.54	0.47	0.50

Description: Regency 1: Jembrana, 2: Tabanan, 3: Buleleng, 4: Badung, 5: Denpasar, 6: Gianyar, 7: Bangli, 8: Klungkung, 9: Karangasem. N = Abundance, H' = Diversity index, E = Similarity index, C = Dominance index

Spatial Distribution

Observations of mealybug population distribution in Bali indicated that all four mealybug species infesting cassava plants were present across all surveyed regencies. Based on elevation above sea level (asl), mealybugs were recorded on cassava plants

at altitudes ranging from 9 m asl in Jembrana Regency, to 973 m asl in Badung Regency (Table 1). Based on the results of population distribution, the four species of mealybugs on cassava plants showed random distribution pattern (Figure 6).

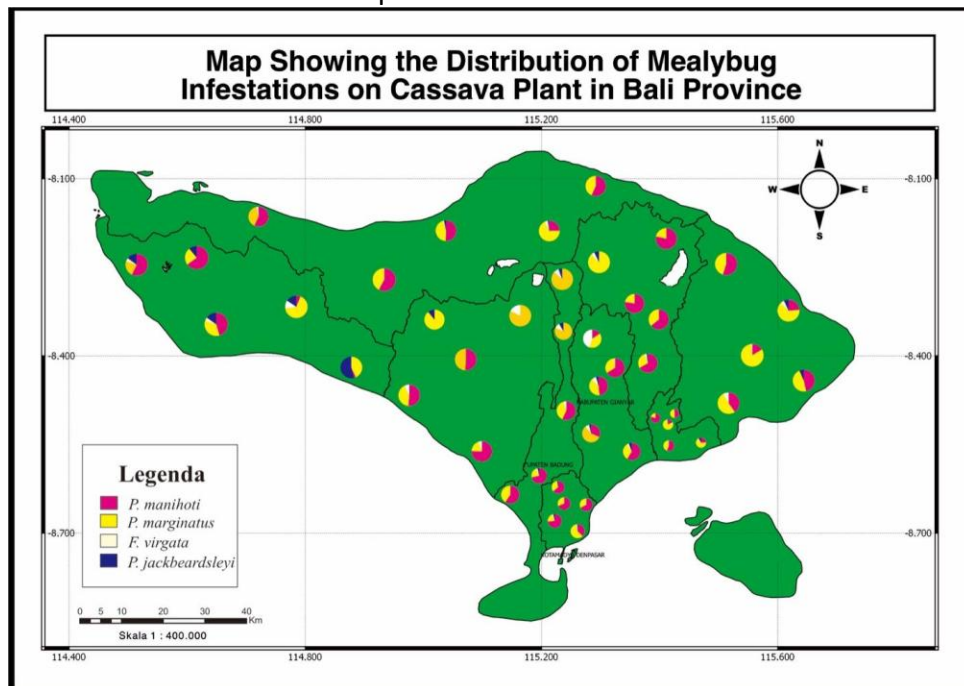


Figure 5. Spatial distribution of mealybug species infesting cassava plants in Bali, Indonesia

Discussion

The composition of mealybugs associated with cassava in Bali was characterized by strong dominance of two species, *Paracoccus marginatus* and *Phenacoccus manihoti*, as shown by their high relative abundances across most regencies

(Figures 3, 4, 5). These results indicate that both species are ecologically well-adapted to cassava agroecosystems in Bali. *P. marginatus* is widely recognized as an invasive pest with a high reproductive capacity and broad host range, while *P. manihoti* is known to thrive in relatively homogeneous cropping systems.

The observed differences in dominance patterns among regencies suggest that local environmental conditions and agroecosystem characteristics may influence species prevalence, as previously reported by Maharani et al. (2016), Hayati (2017), and Wulandari et al. (2018).

The high abundance of *P. manihoti* in urban and peri-urban areas such as Denpasar and Gianyar is likely associated with intensive cassava cultivation practices and relatively uniform cropping systems. In contrast, *P. marginatus* predominated in Karangasem Regency, which may be related to greater host plant diversity and more heterogeneous agroecosystems. Minor species, *F. virgata* and *P. jackbeardsleyi*, consistently occurred at low proportions (<10%) across all locations (Figure 4), indicating lower competitiveness compared with the dominant species. Although present at low densities, these minor species remain ecologically relevant as indicators of community variation within cassava agroecosystems (Abduchalek et al., 2017).

The species richness index (Margalef index) further supported the dominance patterns observed. Dmg values of mealybugs across all regencies were classified as low and relatively homogeneous (Table 1). This pattern was largely influenced by the uniform number of species recorded at each location, indicating that variation in Dmg values was primarily driven by differences in total individual abundance rather than species number (Arya et al., 2023). Regencies with lower overall mealybug abundance, such as Buleleng, exhibited relatively higher Dmg values compared to areas with larger populations, such as Bangli. This finding is consistent with the Margalef index principle, which is sensitive to the ratio between the number of species (S) and the logarithm of the total number of individuals (N). The

consistently low Dmg values (<2.5) across all sites indicate limited species richness of mealybugs in Bali, likely influenced by agroecosystem uniformity, including similar host plant types, climatic conditions, and cultivation systems (Yunus et al., 2022).

Community structure analysis further revealed low overall diversity of mealybugs in Bali. Shannon–Wiener diversity index (H') values across all regencies were below 1.5 (Table 3), indicating low species diversity. Low evenness ($E < 0.30$) indicated an uneven distribution of individuals among species, characterized by the strong dominance of one or two species. This pattern was reinforced by relatively high dominance index (C) values ranging from 0.40 to 0.54 (Table 3). Among the surveyed regencies, Jembrana exhibited the highest diversity ($H' = 1.22$), with comparatively higher evenness ($E = 0.24$) and lower dominance ($C = 0.32$), suggesting a relatively more balanced community structure. In contrast, Bangli exhibited the highest dominance ($C = 0.54$) and the lowest diversity ($H' = 1.04$), primarily driven by the dominance of *P. manihoti*. Ecologically, communities characterized by low diversity and low evenness are generally more susceptible to pest outbreaks, particularly from highly adaptive and invasive species such as *P. marginatus* (Kayoum et al., 2023; Rudra et al., 2024).

The spatial distribution analysis demonstrated that all four mealybug species were widely distributed across Bali Province (Figure 5), occurring from lowland to highland areas. This wide distribution indicates that cassava is a highly suitable host for mealybug development across diverse agroecological conditions, with no apparent geographical barriers limiting species occurrence. The relatively uniform distribution pattern is likely facilitated by the high dispersal ability of mealybugs through both natural mechanisms,

such as wind and animal movement, as well as anthropogenic activities, including the movement of planting materials and agricultural trade. Similar distribution patterns have been reported for highly adaptable insect pests in agricultural landscapes (Fowler & Cohen, 1990). The random distribution pattern occurred due to significant differences in the population numbers of mealybug species at the observation sites (Widjaya, 1994).

From a pest management perspective, the strong dominance of *P. marginatus* and *P. manihoti*, combined with their wide spatial distribution, suggests that mealybug management in Bali should be implemented on a regional scale rather than through isolated, site-specific interventions. Integrated Pest Management (IPM) strategies that emphasize ecological regulation, habitat management, and coordinated control efforts across regencies are therefore essential to reduce outbreak risks, maintain agro-ecosystem stability, and minimize cassava yield losses caused by mealybug infestations.

Conclusion

The results of the study showed four mealybug species: *Phenacoccus manihoti*, *Paracoccus marginatus*, *Ferrisia virgata*, and *Pseudococcus jackbeardsleyi*, with species richness index values ranging from 0.368 to 0.388. All species were recorded in all surveyed regencies and exhibited a predominantly random spatial distribution pattern, as indicated by a variance-to-mean ratio ($S^2/X \approx 1$). Overall dominance was highest for *P. marginatus* (46.23%), particularly in Karangasem, followed by *P. manihoti* (45.72%) in Denpasar. The mealybug community structure was characterized by a diversity index (H') ranging from 0.73 to 1.22, an evenness index (E) ranging from 0.16 to 0.24, and a dominance index (C) ranging from

0.32 to 0.54, indicating spatially variable communities that ranged from relatively stable to less stable conditions. These findings provide the baseline data on the community structure and spatial distribution of mealybugs on cassava in Bali, offering important insights for developing targeted monitoring and sustainable pest management strategies.

Acknowledgment

The author would like to express sincere gratitude to Universitas Dwijendra for the support and facilities provided during the implementation of this research. The author conveys the highest appreciation to all parties who have contributed, both directly and indirectly, to the successful completion of this research and the writing of this article.

Declarations

Author contributions

Made Mika Mega Astuthi was the primary contributor to the writing of this manuscript and served as the corresponding author. Dicky Marsadi and I Wayan Dirgayana were co-authors. All authors have read and approved the final version of the manuscript

Funding

This research was funded by the Research and Community Service Program of the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia (BIMA–Kemendikbudristek) through the *Penelitian Dosen Pemula (PDP)* scheme for the fiscal year 2025, under Contract Numbers 129/C3/DT.05.00/PL/2025 and 2166/LL8/AL.04/2025.

Conflict of interest

The authors declare that there are no financial or personal relationships that could have influenced the work reported in this article.

References

- Abdulahalek B, A Rauf, Pudjianto. 2017. Kutu Putih Singkong, *Phenacoccus manihoti* Matile-Ferrero (Hemiptera: Pseudococcidae): Persebaran geografi di pulau jawa dan rintisan pengendalian hayati. Jurnal Hama dan Penyakit Tropika 17(1): 1 – 8. DOI. 10.23960/j.hppt.1171-8
- Andini M, EC Lina, N Nelly. 2025. Toxicity and developmental disruption of *Piper aduncum* nanoemulsion against *Paracoccus marginatus* under laboratory conditions. JPT: Jurnal Proteksi Tanaman (Journal of Plant Protection) 9(1): 48-57. DOI. 10.25077/jpt.9.1.48-57.2025
- Arya MHA, L Sitti, S Hasyyati. 2025. Keanekaragaman, kekayaan, dan pemerataan jenis tumbuhan di blok perlindungan tahura nuraksa pulau Lombok. Jurnal Hutan Pulau – Pulau Kecil 20(1): 11-21. <http://ojs3.unpatti.ac.id/index.php/jhppk>
- Atusholihah S, SDE Maharatih, A Fuad. 2020. Inventarisasi serangan hama kutu putih (*mealybug*) pada tanaman singkong di Kecamatan Rogojampidan Singojuruh. Jurnal Biosense 3(2): 14-24. DOI. 10.36526/biosense.v3i2.1156
- Badriasih K, IW Supartha, IW Susila. 2019. Kepadatan populasi dan pola penyebaran lalat buah (*Bactrocera* Spp.) (Diptera: Tephritidae) yang menyerang buah mangga (*Mangifera Indica* L.) di Kabupaten Buleleng. Jurnal Agroekoteknologi Tropika 8(3): 294-301. <https://ojs.unud.ac.id/index.php/jat/article/view/51599>
- Fowler J dan L Cohen. 1990. Practical statistics for field biology. John Wiley & Sons. New York.
- Hayati EE. 2017. Biologi dan neraca hayati kutu putih singkong, *Phenacoccus manihoti* Matile-ferrero (Hemiptera: Pseudococcidae) pada tanaman *Tanilum paniculatum*. [Skripsi]. IPB. Bogor.
- Hidayani, K Ujang, R Fadilla, I Zahlul. 2019. Jenis dan tingkat serangan hama utama tanaman ubi kayu (*Manihot esculenta* Crantz) di Kabupaten Lima Puluh Kota. JPT: Jurnal Proteksi Tanaman (Journal of Plant Protection) 3(1): 85-92. DOI: 10.25077/jpt.3.2.85-92.2019.
- Kayoum YA, FN Bouris, YFJ Agrippine, TS Junior, NS Babell, KE Laure, M Mohammadou, M Kenne. 2023. Biodiversity and community structure of arboreal foraging ants (Hymenoptera: Formicidae), mealybugs (Hemiptera: Sternorrhyncha: Coccoidea) and host plants in Douala, Littoral-Cameroon. Asian Journal of Research in Crop Science 8(4): 83-108. DOI. 10.9734/AJRCS/2023/v8i4191
- Lovalini D, T Jumsun dan Hidayani. 2016. Jenis dan tingkat serangan hama kutu putih dan tungau merah pada tanaman ubi kayu (*Manihot esculenta* Crantz) di Kota Padang. [Tesis]. Universitas Andalas. Padang.
- Magurran AE. 2004. Measuring Biological Diversity. Blackwell Publishing. Oxford. United Kingdom.
- Maharani Y, A Rauf, D Sartiami, Anwar. 2016. Biologi dan neraca hayati kutu putih *Paracoccus marginatus* William & Granara De Willink (Hemiptera: Pseudococcidae) pada tiga jenis tumbuhan inang. Jurnal Hama dan Penyakit Tumbuhan Tropika 16(1): 1-9. DOI: 10.23960/j.hppt.1161-9.
- Nurmasari F. 2015. Keanekaragaman kutu putih dan musuh alami pada tanaman singkong (*Manihot esculenta* crantz). [Tesis]. Universitas Jember. Jember.
- Odum EP. 1996. Dasar-dasar ekologi (Terjemahan, T. Samingan). Gadjah Mada University. Yogyakarta.
- Pangestu WW. 2017. Komposisi spesies parasitoid kutu daun pada beberapa jenis tanaman inang. [Skripsi]. Universitas Jember. Jember.
- Pramesti, Surya, SR Endang, Agustono. 2017. Analisis daya saing ubi kayu indonesia di pasar internasional. Jurnal Sepa 14(1):1-7. DOI. 10.20961/sepa.v14i1.21034
- Pusat Data dan Sistem Informasi Pertanian [Pusdatin]. 2015. Outlook ubi kayu. Kementerian Pertanian. Jakarta.
- Rudra NB, KD Mukul, CN Bharat, MG Balaga, P Prabhu, R Naseema, D Priyanka, KS Ashok, B Sinki. 2024. Ecology and management of

- mealybugs in agriculture: A comprehensive overview. *International Journal of Advanced Biochemistry Research* 8(9): 531-533. DOI. 10.33545/26174693.2024.v8.i9Sg.2165
- Sajar S, S Andi, S Maimunah, H Dwi. 2024. Pengenalan dan pengendalian hama dan penyakit tanaman ubi kayu. *Jurnal Peduli Masyarakat* 6(4): 1985-1998. DOI. 10.37287/jpm.v6i4.4991
- Setiawan A, NUW Sebayang. 2022. Identification of Cassava (*Manihot esculenta* Crantz.) Morpho-physiological Traits in the Toba Regency. *IOP Conf. Series: Earth and Environmental Science* 1188: 012031. DOI. 10.1088/1755-1315/1188/1/012031
- Solihin AP, S Suwatan, I Husain. 2024. Hight parasitism parasitism of *Telenomus* and *Trichogramma* Species on *Spodoptera frugiperda* eggs during maize vegetative stage in Gorontalo, Indonesia. *JPT: Jurnal Proteksi Tanaman (Journal of Plant Protection)* 9(1): 38-47. DOI. 10.25077/jpt.9.1.38-47.2025
- Srinurningsih K, Rahim, CJ Lamangantjo, MS Hamidun, R Utina, AS Katili, Hikmawati. 2023. Struktur komunitas lalat buah (diptera: tephritidae) dan tingkat serangan pada tanaman tomat (*Solanum lycopersicum*). *Jurnal Hama Penyakit Tumbuhan* 11(4): 217-226. DOI. 10.21776/ub.jurnalhpt.2023.011.4.5
- Suparno AF, Insafitri, A Romadhon. 2018. Struktur komunitas makrozoobenthos di kawasan ekosistem pesisir pulau sepanjang Kabupaten Sumenep. *Jurnal Ilmiah Rekayasa* 11(1): 53-59. DOI. 10.21107/rekayasa.v11i1.4125
- Wahyuni S, IW Supartha, R Ubaidillah, IN Wijaya. 2017. Parasitoid community structure of leaf miner *Liriomyza* spp. (Diptera: Agromyzidae) and the rate of parasitization on vegetable crops in Lesser Sunda Islands, Indonesia. *Biodiversitas* 18(2): 593-600. DOI. 10.13057/biodiv/d180221
- Widyantoro A, A Badiatul. 2024. Perbedaan spesifik morfologi *Dysmicoccus neobrevipes* dengan kutu putih lainnya pada komoditas pisang. *Jurnal Hama Penyakit Tumbuhan* 12(3): 136-145. DOI. 0.21776/ub.jurnalhpt.2024.012.3.2
- Wulandari K, Asriyana, Halili. 2018. Struktur komunitas ikan di perairan Rawa Aopa Kecamatan Angata Kabupaten Konawe Selatan Provinsi Sulawesi Tenggara. *Jurnal Manajemen Sumber Daya Perairan* 3(1): 75-81. DOI. 10.26418/akuatik%20tropis.v2i2.87512
- Yunus M, N Burhanuddin, AL Sri, LP Reski. 2022. Biodiversity and community structure of Arthropod in tropical rice fields under organic and conventional ecosystems. *Australian Journal of Crop Science*. 16(4): 531-538. DOI. 10.21475/ajcs.22.16.04.p3551
- Zarkani A, A Fauzi, D Apriyanto, MB Kaydan. 2023. Mealybugs (Hemiptera, Coccoomorpha, Pseudococcidae) on parasitic plants (*Loranthaceae*) in Indonesia with description of a new species and a new country record. *Zookeys*: 199-210. DOI. 10.3897/zookeys.1167.106012
- How to cite: Astuthi MMM, D Marsadi, IW Dirgayana. 2025. Community Structure and Spatial Distribution of Mealybugs on Cassava Plants in Bali, Indonesia. *JPT: Jurnal Proteksi Tanaman (Journal of Plant Protection)* 9(2): 83 - 94