

The diversity of fruit flies (*Bactrocera* spp.) in Mango Orchard in Tempuran District, Karawang, West Java

Inayah Alfarida¹, Siti Latifatuss Siriyah^{2*}, Nurcahyo Widyodaru Saputro³, Febrina Herawani⁴

^{1, 2, 3, 4}Faculty of Agriculture, Universitas Singaperbangsa Karawang, Karawang, West Jawa, Indonesia

*Corresponding author: sitilatifatuss@staff.unsika.ac.id

ABSTRACT

Fruit flies (*Bactrocera* spp.) are major pests of mango crops, causing significant declines in production quality and quantity. However, information regarding their species composition in Tempuran District, Karawang Regency, remains limited. This study aims to identify the species composition and analyze the community structure of fruit flies in mango plantations in Panca Karya and Tanjung Jaya Villages. Sampling was conducted from September to November using methyl eugenol traps and the rearing method from infested fruit, followed by identification based on adult morphological characters. A total of 7,016 individuals were successfully collected, consisting of five species: *Bactrocera dorsalis*, *B. correcta*, *B. kandiensis*, *B. zonata*, and *B. occipitalis*. The dominant species was *B. dorsalis* with 3,160 individuals (45.04%). The Shannon-Wiener diversity index (H') was 1.35, indicating a moderate category, while the Simpson dominance index (C) was 0.31, indicating low dominance. Higher individual abundance was found in Panca Karya Village compared to Tanjung Jaya. These results indicate that the fruit fly community in the study area consists of several species with one dominant species; thus, information on community composition and structure can serve as a basis for formulating Integrated Pest Management (IPM) strategies for mangoes based on dominant species. This study provides the first documented baseline data on fruit fly community structure in Tempuran District, which is essential for location-specific Integrated Pest Management strategies.

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INTRODUCTION

Mango (*Mangifera indica* L.) is a strategic horticultural commodity in Indonesia, possessing high economic value and contributing to increased farmers' income (Awaliyah et al., 2022). National mango production continues to expand as demand increases in both domestic and export markets (Kiloes et al., 2024). West Java Province is known as one of the mango production centers, with various cultivation systems ranging from home gardens to plantation-scale. However, the productivity and quality of mango fruits still face various technical obstacles, primarily due to pest attacks (Kusrini et al., 2022; Rasmikayati et al., 2020).

One of the major pests of mango crops is the fruit fly from the family Tephritidae. This group of insects is known as a significant pest of various tropical fruit commodities because their larvae develop within fruit tissues, causing direct damage before harvest (Mokam et al., 2024). Oviposition

by adult females and larval development within the fruit can result in fruit rot, premature fruit drop, and a decline in harvest quality (Momen et al., 2025). Economic losses due to fruit fly infestations have been reported as significant in various mango production centers in tropical regions (Opoku et al., 2025).

The genus *Bactrocera* is a group of fruit flies that are most frequently reported to attack mango crops in Southeast Asia. Several species within the *Bactrocera dorsalis* complex are known to have a wide host range and high adaptability to various agro-ecosystem conditions (Sari et al., 2020; Setiawan et al., 2024). Recent studies indicate that fruit fly species composition in a region can be influenced by environmental factors, host availability, and orchard management practices (Dominiak & Hoskins, 2025; Momen et al., 2025). Therefore, understanding the fruit fly community structure is crucial for supporting control strategies based on dominant species.

Various studies in Indonesia have reported the presence of several *Bactrocera* species in mango plantations using attractant-trap methods and adult morphological identification (Sari et al., 2020). These studies show that the dominant species may differ between locations, even within the same genus group. Such variation indicates that fruit fly community characteristics are location-specific and cannot be broadly generalized (Supratiwi et al., 2020; Syahputera et al., 2022). Therefore, the availability of systematically documented local data is essential for planning targeted pest control.

Tempuran District, located in Karawang Regency, is a major center of mango production, where intensive cultivation and widespread mango monoculture create distinct ecological conditions for fruit flies and their parasitoids. Nevertheless, scientific information on species composition, diversity levels, and fruit fly dominance in mango plantations in this region remains limited in the scientific literature. The lack of such baseline data potentially limits the formulation of control strategies based on key species at the local level. Therefore, a study of fruit fly community structure in this region is relevant and urgent. Despite numerous studies on fruit flies in Indonesia, no published data have specifically documented the community structure of *Bactrocera spp.* in Tempuran District, Karawang Regency. Given the intensifying mango cultivation in this region, localized ecological data are urgently needed.

Although several studies have reported fruit fly diversity in various mango-producing regions in Indonesia, most investigations have focused on species presence and abundance without a detailed analysis of community structure at the village scale. Moreover, ecological baseline data at the sub-district level remain scarce, particularly in rapidly intensifying mango-producing areas such as the Tempuran District. This limitation constrains the development of location-specific Integrated Pest Management (IPM) strategies, which require accurate knowledge of dominant species and community dynamics.

Given the lack of comprehensive data on fruit fly communities in Tempuran District's mango plantations, this study provides baseline information on species identification and community composition using adult morphological identification and community analysis approaches. Specifically, this study aims to: (1) identify fruit fly species found in mango plantations, (2) analyze the composition, diversity, and dominance of fruit flies, and (3) compare the characteristics of fruit fly communities in two villages in Tempuran District. It is hypothesized that *Bactrocera dorsalis*

would dominate the fruit fly community due to its known ecological plasticity and host range. The results of this study are expected to provide a scientific basis for planning more effective fruit fly control tailored to local conditions.

METHOD

This study used an ecological survey approach with a comparative design across locations to analyze fruit fly community structure in two mango agro-ecosystems in the Tempuran District, Karawang Regency. The research focused on identifying species composition and analyzing community structure based on diversity and dominance indices.

The study was conducted from September to November, coinciding with the fruit formation-to-maturation phases—a period ecologically supportive of increased oviposition activity and fruit fly population development (Momen et al., 2025). The fruit flies were collected twice a month at two locations, including Pancakarya Village and Tanjung Jaya Village, both of which are smallholder mango cultivation areas with relatively similar orchard management systems.

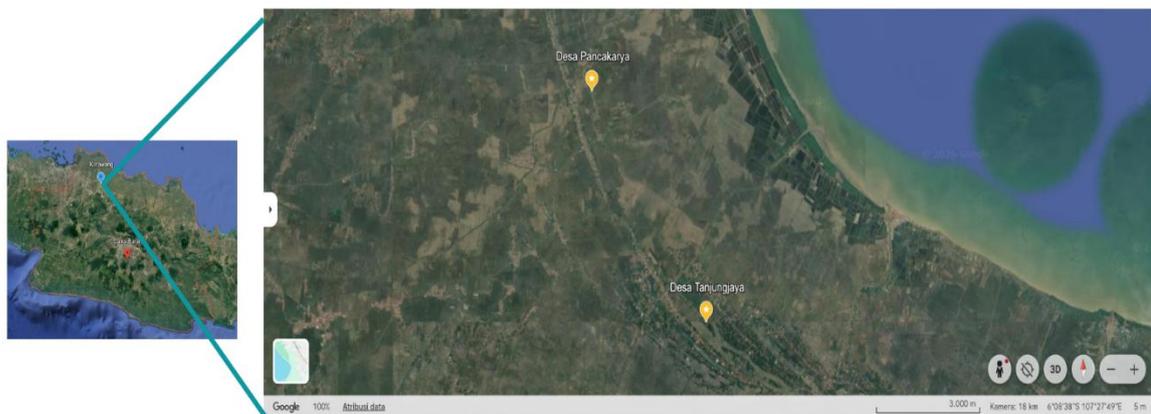


Figure 1. Map of fruit fly sampling locations in Mango Plantations in Tempuran district, Karawang regency

The observation sites were located in two villages in Tempuran District, Karawang Regency, at an altitude of approximately 5.6 meters above sea level. The site in Tanjungjaya Village (6.1803430° S, 107.4432050° E) consisted of a mango plantation covering approximately 2 ha with an average plant age of about 10 years, while the site in Pancakarya Village (6.1816140° S, 107.4391630° E) comprised a separate mango plantation area of approximately 1.65 ha with a dominant plant age of about 30 years under similar altitude conditions. Both orchards cultivated two mango varieties, namely Indramayu and Gede Raja. This area is planted with two mango varieties, namely Harum Manis and Indramayu, which are well-adapted to lowland agro-ecosystems and have high economic value (Ruswandi, 2020).

The Indramayu variety is generally characterized by medium-sized, oblong-oval fruits with greenish-yellow skin at maturity and a dominant sweet taste. In contrast, the Gede Raja variety has relatively larger fruits, a more round-oval shape, thicker skin, and thick flesh with a balanced sweet-sour taste (Indrajati et al., 2021). The Harum Manis variety is characterized by medium-to-large fruits, an oblong shape, greenish-yellow skin at maturity, and a strong aroma with a dominant sweet taste (Hakim et al., 2021). The fruiting period lasts approximately two months, from set to harvest in

August–September. This phenological cycle determines the availability of mango fruit as the primary host for fruit flies during the observation period (Field, Saputra (Saputra et al., 2024).



Figure 2. The mango orchard in (2a) Tanjungjaya village, and (2b) Pancakarya village

The research population comprised all fruit fly individuals (Diptera: Tephritidae) associated with mango plants at the study sites. The sample unit consisted of fruit fly individuals caught using attractant traps and adults obtained by rearing fruit flies from infested fruit. In each village, five traps were installed, spaced 15 m apart, to minimize overlap of attraction areas.

Fruit fly collection was performed using baited traps containing plastic bottle traps with methyl eugenol attractant, which is known to be effective in attracting male fruit flies, particularly from the *Bactrocera dorsalis* complex. Traps were installed for 24 hours at a height of 2 meters above the ground. Captured fruit flies were preserved in 70% alcohol for identification. Additionally, mango fruits showing symptoms of fruit fly attack were collected and reared in a cage containing sawdust until adults emerged. Since methyl eugenol predominantly attracts male *Bactrocera* species, the results may not fully represent the structure of the female population.

Morphospecies identification was conducted using a stereo microscope based on adult morphological characters, including thorax patterns, abdominal bands, and wing characters. It was supported by the identification keys by Drew and Hancock, as well as the Australian Fruit Fly Identification System (M. Schutze et al., 2018). The data on the number of fruit fly individuals were analyzed to determine community structure using the Shannon-Wiener Diversity Index (H') and the Simpson Dominance Index (C). Calculations were based on the proportion of individuals of each species among all individuals caught (Magurran, 2003; Martuti & Anjarwati, 2022).

The Shannon-Wiener Diversity Index was calculated using the formula:

$$H' = -\sum p_i \ln p_i \quad (1)$$

Where H' is the Shannon-Wiener diversity index, p_i is the proportion of individuals of the i -th species to the total individuals ($p_i = n_i/N$), n_i is the number of individuals of the i -th species, N is the total number of individuals of all fruit fly species found, The value is categorized as low ($H' < 1$), moderate ($H' = 1-3$), and high ($H' > 3$) (Martuti & Anjarwati, 2022). The Simpson Dominance Index was calculated using the formula (2):

$$C = \sum p_i^2 \quad (2)$$

Where C is the Simpson dominance index, C ranges from 0 to 1, with values approaching 0 indicating low dominance and values approaching 1 indicating high dominance (Martuti & Anjarwati, 2022).

RESULTS AND DISCUSSION

Morphospecies Composition

This study successfully identified five fruit fly morphospecies of the genus *Bactrocera* associated with mango plantings in the Tempuran District, Karawang Regency, totaling 7,016 individuals captured during the observation period. These five species are *Bactrocera dorsalis*, *B. correcta*, *B. kandiensis*, *B. zonata*, and *B. occipitalis*. The distribution of individual numbers at each location and the relative proportion of each species are presented in Table 1.

Table 1. Number of individuals and percentage of fruit flies in mango plantations in Tempuran District

No	Morphospecies	Pancakarya	Tanjungjaya	Total	Percentage (%)
1	<i>Bactrocera dorsalis</i>	2091	1069	3160	45,04
2	<i>Bactrocera correcta</i>	1517	386	1903	27,13
3	<i>Bactrocera kandiensis</i>	684	271	955	13,61
4	<i>Bactrocera zonata</i>	450	202	652	9,29
5	<i>Bactrocera occipitalis</i>	240	105	345	4,92
	Total	4983	2033	7016	100

Based on Table 1, *Bactrocera dorsalis* was the species with the highest number of individuals, totaling 3,160 or 45.04% of the total captured population (Figure 3). This proportion indicates that nearly half of the total fruit fly community found was dominated by a single species. This relative dominance is consistent with recent reports indicating that *B. dorsalis* is a complex species with broad adaptability to tropical host plants, including mango (Dominiak & Hoskins, 2025; Koswanudin et al., 2018).

The species with the second-highest abundance was *B. correcta* (27.13%), followed by *B. kandiensis* (13.61%). Meanwhile, *B. zonata* and *B. occipitalis* were found in lower proportions, each below 10%. This distribution pattern suggests that the fruit fly community structure at the study site is not fully centralized on a single species, although a single species is quantitatively dominant (Nage et al., 2023). Similar patterns have also been reported in mango agroecosystems in other tropical regions, where one species tends to dominate the community, while several accompanying species remain present (Sari et al., 2020).

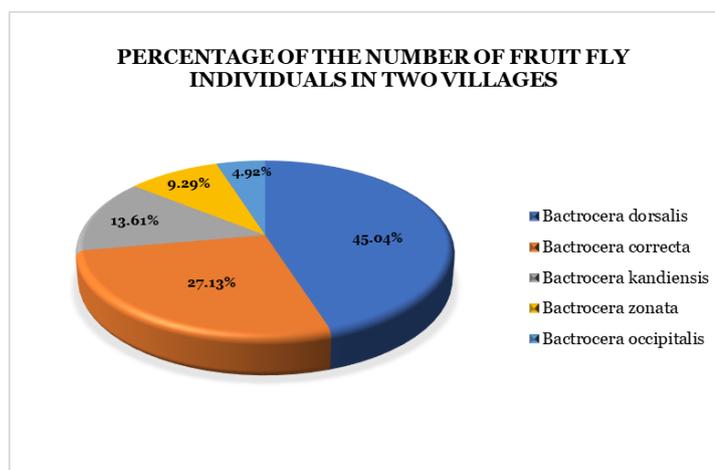


Figure 3. Diagram of the proportion of morphospecies composition of the fruit fly in Tempuran, Karawang.

A comparison between locations showed that Pancakarya Village had a higher number of individuals than Tanjung Jaya Village (Figure 4). This difference may reflect variations in agro-ecosystem conditions across locations. Several studies report that variations in host availability, harvest intensity, and orchard management can influence fruit fly population dynamics (Nanga et al., 2022; Tarno et al., 2025). Therefore, the differences in individual numbers between locations in this study should be understood as ecological indicators requiring further study.

The higher abundance observed in Pancakarya Village may be related to orchard age structure, host density, and canopy complexity. Older orchards (± 30 years) may provide more stable microclimatic conditions and continuous fruit availability compared to younger orchards, potentially supporting higher fruit fly survival and reproduction rates. Additionally, differences in sanitation practices and in fallen fruit management could significantly influence the success of larval development. Similar patterns have been reported in perennial fruit systems where orchard age and structural complexity influence tephritid population dynamics (Mokam et al., 2024; Nanga et al., 2022).

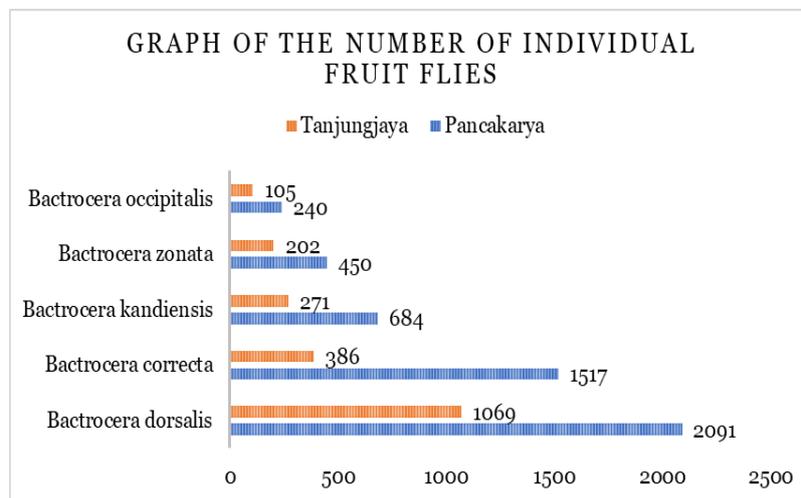


Figure 4. A graphic of the number of *Bactrocera* species distributed in both Tanjungjaya village and Pancakarya village

Data Analysis

The analysis of community structure yielded a Shannon-Wiener Diversity Index (H') value of 1.35. Based on general criteria used in insect ecology studies, this value falls into the moderate diversity category (Dirham et al., 2025). This value indicates that the fruit fly community comprises several species, with individuals distributed unevenly across species. In line with this pattern, similar dominance structures have been reported in other tropical mango agroecosystems in Indonesia, such as in Bangka Belitung, where *Bactrocera dorsalis* and *Bactrocera carambolae* were the most abundant species, suggesting that intensive fruit cultivation can shape species composition in Southeast Asian orchards (Dirham et al., 2025; Octavia et al., 2021; Saputra & Afriyansyah, 2021).

The Simpson Dominance Index (C) value of 0.31 indicates a relatively low-to-moderate level of dominance. Although a single species has the highest number of individuals, the community is not fully or extremely dominated by a single species. This condition suggests that interspecific interactions in the mango plantation system of Tempuran District still allow species coexistence, as reflected by the moderate diversity and relatively balanced dominance values. Comparable studies in Indonesian

mango orchards have likewise found moderate diversity with co-occurrence of multiple *Bactrocera* species, such as in Surabaya, where *B. carambolae* and *B. dorsalis* dominated yet showed moderate diversity patterns ($H' 0.77-1.15$), indicating that similar agroecosystem contexts can shape fruit fly community structure (Herdi et al., 2024; Li et al., 2025; Sari et al., 2020).

Fruit Fly Morphological Characters

Morphospecies identification was carried out based on external morphological characters, including the color and pattern of the thorax, abdominal patterns, and wing characteristics. Species determination refers to the identification key for the fruit fly genus *Bactrocera*, widely used in modern taxonomic research (M. Schutze et al., 2018).

The morphospecies *Bactrocera dorsalis* (Figure 5a) is characterized by a dark brown thorax with clear lateral yellow bands (vittae). The abdomen shows a transverse black band pattern on the middle segments (T3), while the wings are transparent with a brown costal band extending almost to the wing tip. These characters correspond to the morphological description of the *dorsalis* complex in current taxonomic literature (Linda et al., 2018; M. Schutze et al., 2018; Simanjuntak & Syamsulhadi, 2025).

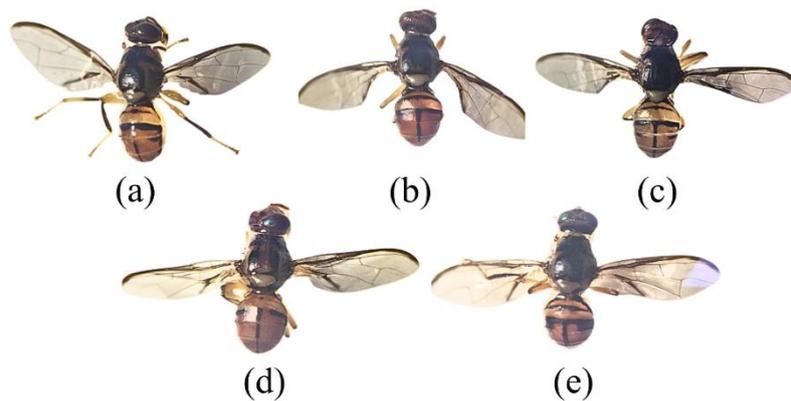


Figure 5. Morphospecies of *Bactrocera* spp from the dorsal view: (a) *Bactrocera dorsalis*; (b) *Bactrocera correcta*; (c) *Bactrocera kandiensis*; (d) *Bactrocera zonata*; (e) *Bactrocera occipitalis*

The species *B. correcta* (Figure 5b) possesses a blackish-brown thorax with a combination of relatively narrower yellow bands. The abdomen appears slenderer with black bands that do not fully fuse on every segment. This difference in abdominal pattern is one of the main distinguishing characteristics of *B. dorsalis* in field morphological identification (Jaleel et al., 2021; M. Schutze et al., 2018).

The morphospecies *B. kandiensis* (Figure 5c) exhibits a yellowish-brown body color with a relatively lighter thorax. The abdominal band appears thin and broken at the median section. These characters help distinguish this species from others with more distinct abdominal bands (Madushan et al., 2023; M. K. Schutze et al., 2017).

The species *B. zonata* (Figure 5d) is characterized by a reddish-brown body color with contrasting yellow patterns on the thorax. The abdomen shows relatively thicker black bands compared to other species in this study (Koohekazade et al., 2018; M. K. Schutze et al., 2017).

The species *B. occipitalis* (Figure 5e) has a predominantly black thorax with limited yellow markings and narrow, elongated abdominal bands. The differences in morphological characters

between these species support the validity of the identification conducted (Barr et al., 2021; Larasati et al., 2016; M. Schutze et al., 2018).

CONCLUSION

This study identified five fruit fly species of the genus *Bactrocera* in mango plantations in Tempuran District: *Bactrocera dorsalis*, *B. correcta*, *B. kandiensis*, *B. zonata*, and *B. occipitalis*, with a total of 7,016 individuals caught during the observation period. The community structure showed a relative dominance of *B. dorsalis* (45.04%) with moderate diversity ($H' = 1.35$) and non-extreme dominance ($C = 0.31$), alongside differences in individual numbers between the two research locations. These findings indicate that the fruit fly community in the region is composed of one dominant species and several accompanying species in lower proportions. These findings indicate that the fruit fly community in the region is composed of one dominant species and several accompanying species in lower proportions. The dominance of *B. dorsalis* suggests that management strategies in the Tempuran District should prioritize this species as the primary target of control measures. The moderate diversity and non-extreme dominance values indicate that current agro-ecosystem conditions still allow multispecies coexistence; however, shifts in orchard management intensity could alter community balance. Therefore, continuous monitoring is essential to prevent potential outbreak risks associated with the dominant fruit fly species. Future studies should incorporate molecular identification methods and seasonal monitoring to understand long-term population dynamics better.

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