



Host Susceptibility Patterns of Local Chili Varieties to *Bactrocera* spp. in West Sumatra: Diversity, Infestation, and Cluster Analysis

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Abstract

Fruit flies (Diptera: Tephritidae) are major pests of chili (*Capsicum annuum* Linnaeus) in tropical agroecosystems, but information on species dominance, infestation levels, and field susceptibility patterns of local chili varieties in West Sumatra remains limited. This study investigated *Bactrocera* spp. diversity, infestation levels, and varietal susceptibility patterns across four major chili-producing regencies in West Sumatra, Indonesia. Field surveys were conducted from July 2024 to March 2025 at 33 chili-growing sites in Agam, Solok, Tanah Datar, and Padang Pariaman. Fruit flies were monitored using methyl eugenol-baited modified Lynfield traps, while plant and fruit infestation were assessed through field observation and fruit dissection. Species diversity was evaluated using Shannon–Wiener, Simpson, and Pielou evenness indices. Differences in infestation among varieties were analyzed using the Kruskal–Wallis followed by Dunn’s multiple comparison test, while exploratory PCA and clustering were used to visualize infestation patterns. This study identified three fruit fly species associated with chili agroecosystems in West Sumatra, namely *Bactrocera dorsalis*, *B. carambolae*, and *B. umbrosa*. Among them, *Bactrocera dorsalis* overwhelmingly dominated the assemblages, resulting in low species diversity and evenness across regencies. Infestation levels differed among varieties, with Kuhay consistently showing the lowest plant, fruit, and overall infestation intensity. Aka, Keriting Bukittinggi, Rawit, and Kopay showed relatively higher infestation levels, although Kopay should be interpreted cautiously due to limited sample representation. These findings indicate differential field susceptibility among local chili varieties and suggest that low-infestation varieties such as Kuhay warrant further evaluation for integrated pest management and resistance-oriented breeding programs.

Keywords: *Bactrocera dorsalis*, *Capsicum annuum*, fruit fly, host plant resistance, phenotypic diversity

Introduction

Chili (*Capsicum annuum* Linnaeus) is one of the most economically important vegetable crops cultivated in tropical and subtropical regions because of its high commercial value,

culinary importance, and contribution to smallholder income (Mariyono, 2017; Anwarudin et al., 2019). In Indonesia, chili is a strategic horticultural commodity, and its production stability is important for farmer

livelihoods and market supply. West Sumatra is recognized as one of the major chili-producing provinces in Indonesia, with extensive cultivation across diverse agroecological zones, from lowland to highland regions. Major production centers include Agam, Solok, Tanah Datar, and Padang Pariaman regencies, which collectively contribute to provincial chili production (BPS West Sumatra, 2020; Badan Pusat Statistik Provinsi Sumatera Barat, 2024).

Despite its economic importance, chili production in this region has increasingly been constrained by biotic stresses, particularly insect pests. Among these, fruit flies of the genus *Bactrocera* are the most destructive pests affecting horticultural crops in tropical regions. Fruit fly infestation reduces yield and fruit quality because larvae feed internally within developing fruits, causing tissue damage, premature fruit drop, secondary microbial infection, and substantial market losses (Vargas et al., 2012; Mefta and Fauzana, 2021; Amri et al., 2024). Among economically important species, *Bactrocera dorsalis* has emerged as one of the most dominant and invasive fruit fly pests throughout Southeast Asia and other tropical regions (Vargas et al., 2015). The ecological success of *B. dorsalis* has been associated with its high reproductive capacity, broad host range, strong dispersal ability, and adaptability to tropical environments (Drew & Romig, 2013; Qin et al., 2018). These biological traits enable *B. dorsalis* to exploit a wide range of host plants and contribute to its frequent dominance in tropical horticultural agroecosystems.

In chili, direct yield losses occur when maggots feed inside the fruits, reducing productivity by 30–90.1% (Hasinu et al., 2020; Jamaluddin et al., 2020). In addition, indirect losses arise from quarantine restrictions and increased management costs (Heather, 2008; Dhami et al., 2016; Rwomushana et al., 2019).

In West Sumatra, several *Bactrocera* spp. have been reported in vegetable-based agroecosystems; however, their relative dominance and infestation patterns on chili remain insufficiently quantified (Budiyanti et al., 2019).

Fruit fly monitoring using methyl eugenol-baited traps is widely used to detect and monitor *B. dorsalis* populations because methyl eugenol is a strong male attractant for this species (Tan et al., 2021; Fan et al., 2022; Zhang et al., 2025). However, trap-based dominance patterns should be interpreted carefully, as methyl eugenol may disproportionately capture methyl-eugenol-responsive males and may not fully represent the entire fruit fly community in the field. Therefore, combining trap-based species composition with direct infestation assessment is important to better understand the relationship between fruit fly occurrence and crop damage under field conditions.

Previous studies in Indonesia have largely focused on species inventories or general infestation reports of fruit flies on chili and other vegetable crops (Siwi et al., 2006; Suputa, 2010; Hasyim, 2014; Muryati et al., 2017; Budiyanti et al., 2019). Furthermore, studies on chili–*B. dorsalis* interactions have shown that chili genotypes may differ in their susceptibility to infestation, and such variation can be associated with antixenosis, antibiosis, and fruit morphochemical characteristics (Syamsudin et al., 2019; Syamsudin et al., 2022; Abdullah et al., 2023). Syamsudin et al. (2019) reported variation in antixenosis and antibiosis responses among chili varieties against *B. dorsalis*, while Syamsudin et al. (2022) further indicated that differences in resistance levels may be associated with fruit traits under field conditions. These findings suggest that host plant characteristics can influence oviposition preference, larval establishment, and

infestation intensity. Nevertheless, most available studies have not integrated fruit fly species composition, dominance structure, field infestation levels, and varietal susceptibility patterns within the same local agroecosystem.

Quantitative assessments linking *Bactrocera* community structure with infestation intensity across different local chili varieties, therefore, remain underexplored in West Sumatra. This gap is important because local chili varieties may differ in field susceptibility due to variations in fruit morphology, biochemical composition, and volatile organic compounds influencing oviposition behavior and larval development (Syamsudin et al., 2019; Syamsudin et al., 2022; Abdullah et al., 2023). Such information is needed to identify local varieties with consistently lower field infestation and to support the development of more sustainable fruit fly management strategies. Therefore, this study aimed to: (1) identify *Bactrocera*

species associated with chili agroecosystems in West Sumatra; (2) quantify fruit fly dominance patterns across major chili-producing regencies; (3) compare infestation levels among local chili varieties; and (4) evaluate exploratory multivariate patterns of varietal susceptibility based on infestation parameters.

Methods

Study Area and Sampling

Field surveys were conducted from July 2024 to March 2025 in four major red chili-producing regencies of West Sumatra, Indonesia, namely Agam (0°17'S, 100°09'E), Tanah Datar (0°27'S, 100°35'E), Solok (0°47'S, 100°39'E), and Padang Pariaman (0°37'S, 100°13'E). A total of 33 chili-growing fields cultivated with local varieties were surveyed, ranging in elevation from 15 to 1571 meters. Sampling consisted of 12 sites in Agam, 9 sites in Tanah Datar, 7 sites in Padang Pariaman, and 5 sites in Solok (Figure 1).

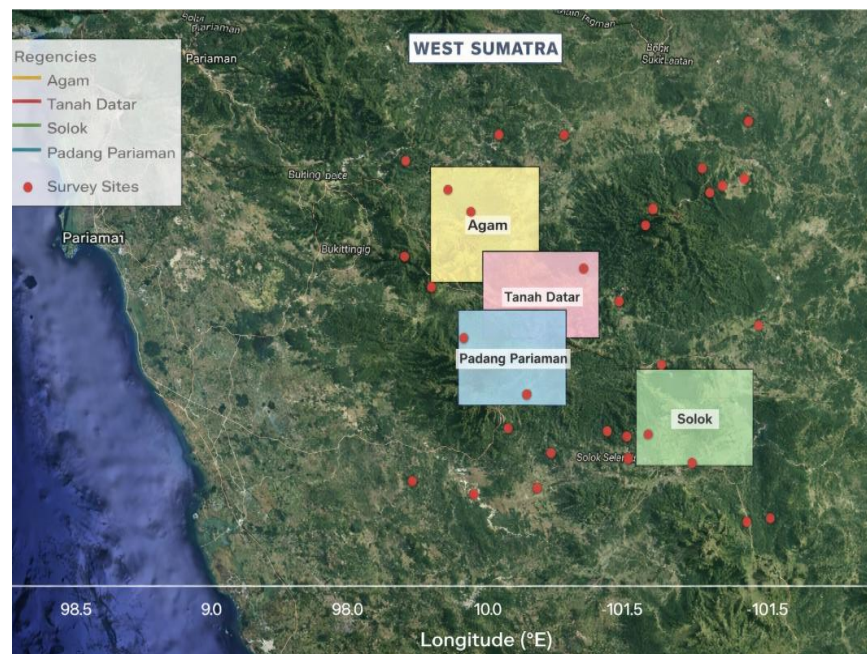


Figure 1. Distribution of chili field sampling sites across four regencies in West Sumatra, Indonesia

Sampling locations were selected purposively based on active cultivation of only one chili variety, minimum field size (>400 m²), and crop growth stage. Only fields at the

reproductive or fruiting stage were included because fruit fly infestation is generally most evident during fruit development (Table 1).

Table 1. Sampling sites, elevation, and local chili varieties evaluated in West Sumatra, Indonesia

Regency	Local chili variety	Elevation (m asl)	No. of fields	No. of observed plants	No. of observed fruits
Agam	Aka	465-1175	1	10	100
	Kuhay		2	20	200
	Keriting		7	70	700
	Bukittinggi				
	Kopay		-	-	-
	Rawit		2	20	200
Solok	Aka	1356-1571	3	30	3
	Kuhay		-	-	-
	Keriting		1	10	100
	Bukittinggi				
	Kopay		1	10	100
	Rawit		-	-	-
Tanah Datar	Aka	308-1133	5	50	500
	Kuhay		-	-	-
	Keriting		1	10	100
	Bukittinggi				
	Kopay		1	10	100
	Rawit		2	20	200
Padang	Aka	15-1168	-	-	-
Pariaman	Kuhay		4	40	400
	Keriting		1	10	100
	Bukittinggi				
	Kopay		-	-	-
	Rawit		2	20	200
Total			33	330	3330

Fruit Fly Trapping and Identification

Modified Lynfield traps constructed from recycled plastic bottles were used for fruit fly monitoring. Each trap contained four lateral entry holes (6-8 mm diameter) and was suspended approximately 1.5 m above ground level at the center of each sampling plot. Traps were baited with 1.5 mL of methyl eugenol applied to cotton wicks and operated during daytime (07:00-19:00 WIB) following Mayasari et al. (2019) (Figure 2). Captured

flies were preserved in 70% ethanol for subsequent morphological identification using standard taxonomic keys based on thoracic, wing, and abdominal characteristics (Siwi et al., 2006; Larasati et al., 2016).

Assessment of Infestation Levels

Infestation assessments were conducted directly in the field using visual observations and a rectangular diagonal sampling method by randomly selecting 10

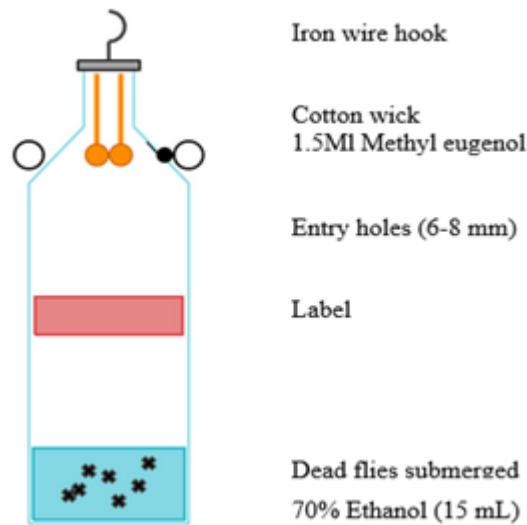


Figure 2. Modified Lynfield trap baited with methyl eugenol for fruit fly monitoring

plants and 100 fruits per field, while fruit infestation was determined based on external symptoms and confirmed by fruit dissection to detect the presence of larvae, using the following formula (Kakar et al., 2014):

$$Ip = \frac{np}{N} \times 100 \quad \dots\dots\dots (1)$$

Where: Ip = infested plant (%), np = number of infested plants, N = total observed plants

$$If = \frac{nf}{T} \times 100 \quad \dots\dots\dots (2)$$

Where: If = infested fruit (%), nf = number of infested fruits, T = total observed fruits

Diversity Indices

The diversity of fruit fly species based on the Shannon-Wiener diversity (H'), Simpson diversity (D), and Evenness (E) (Pielou, 1966; Magurran, 1988):

$$H' = -\sum_{i=1}^s (p_i) \log(p_i) \quad \dots\dots\dots (3)$$

Where: s = number of species in the community, p_i = proportion of total abundance represented by its species

$$1 - D = \sum \left(\frac{n_i}{N} \right)^2 \quad \dots\dots\dots (4)$$

Where: n = Individual number of species, N = Total number of individuals from all species

$$E = \frac{H'}{\ln(S)} \quad \dots\dots\dots (5)$$

Where: H' = Shannon index, S = number of species

Data Analysis

Species diversity was descriptively evaluated for each regency using the Shannon–Wiener diversity index (H'), Simpson's diversity index (D), and Pielou's evenness index (E). The assumptions of normality and homogeneity of variance were tested using the Shapiro–Wilk and Levene's tests, respectively. Because the infestation data did not meet the assumptions for parametric analysis ($p < 0.05$), differences among chili varieties were analyzed using the non-parametric Kruskal–Wallis test, followed by Dunn's post hoc multiple comparison test. K-means and hierarchical clustering analyses were conducted using infestation-related variables. Hierarchical clustering was performed using Ward's linkage method to maximize within-cluster homogeneity and minimize between-cluster variance. The resulting grouping patterns were visualized using dendrograms and principal component analysis (PCA) ordination plots. All statistical analyses were performed using R version 4.4.3.

Results

Composition and Relative Abundance

Three *Bactrocera* species were recorded across the surveyed red chili fields: *B. dorsalis*, *B. carambolae*, and *B. umbrosa*. Species identification was based on external morphological characters, particularly wing pattern, thoracic markings, and abdominal pattern. *B. dorsalis* was recognized by its clear wings with a distinct costal band and typical abdominal marking, whereas *B. carambolae*

showed similar general morphology but differed in the abdominal pattern and wing markings. *B. umbrosa* was clearly

distinguished from the other two species by the presence of broad transverse dark bands across the wings (Figure 3).

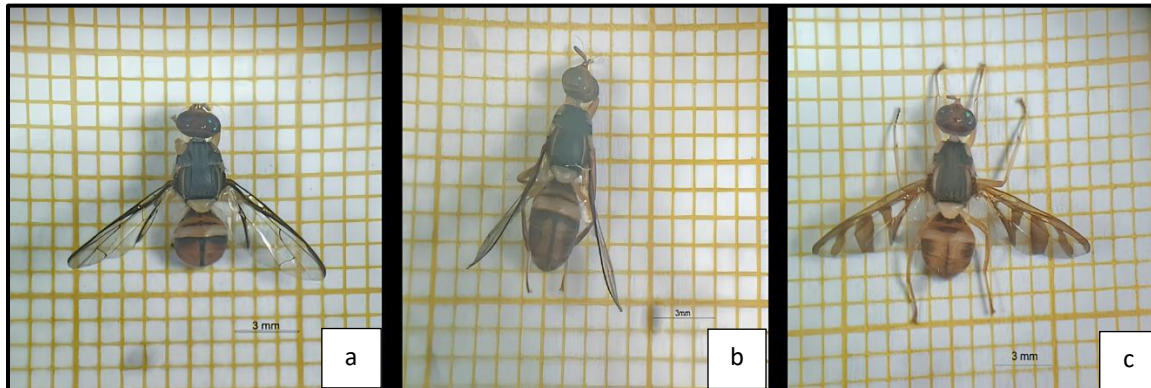


Figure 3. Morphological features of fruit fly species captured in chili fields, West Sumatra, Indonesia: a. *Bactrocera dorsalis*, b. *Bactrocera carambolae*, c. *Bactrocera umbrosa*

Among them, *B. dorsalis* was overwhelmingly dominant, representing 98.9% of the total captures (2,417 of 2,448 individuals). This species consistently showed the highest trap abundance across all locations, with some sites in Solok exceeding 452 individuals per trap. In contrast, *B.*

carambolae was detected at much lower abundance, accounting for only 0.9% (22 individuals), and was mainly observed in mid-altitude areas of Tanah Datar and Solok, often co-occurring with *B. dorsalis*. *B. umbrosa* was rarely detected, comprising only 0.2% of the total captures (9 individuals) (Table 2).

Table 2. Relative abundance and proportion of *Bactrocera* spp. captured in four chili-producing regencies in West Sumatra, Indonesia

Regency	<i>B. dorsalis</i>	<i>B. carambolae</i>	<i>B. umbrosa</i>	Total
Tanah Datar	668	10	0	678
Solok	1,080	10	0	1,090
Agam	460	0	9	469
Padang Pariaman	209	2	0	211
Total	2,417	22	9	2,448
Proportion (%)	98.9	0.9	0.2	

Diversity Indices

The *Bactrocera* community in Agam had the highest diversity ($H' = 0.095$), indicating a relatively more even fruit fly community than those in the other regencies. In contrast, Solok and Padang Pariaman showed very low species diversity. The low diversity was mainly associated with the overwhelming dominance of *B. dorsalis*, which reduced community

evenness across locations. A similar pattern was observed for the dominance index (1-D). The *Bactrocera* community in Solok had the lowest dominance (0.018), whereas Agam had the highest (0.038), further indicating that trap captures in Solok were strongly dominated by a single species. The evenness index (E) also supported this pattern. Agam (0.137) and Tanah Datar (0.111) showed

relatively higher evenness, whereas Solok had the lowest (0.075). Overall, the diversity and evenness of *Bactrocera* communities were

consistently low across all surveyed regencies, with Shannon–Wiener index values below 0.10 (Table 3).

Table 3. Species composition and diversity indices of *Bactrocera* spp. in West Sumatra, Indonesia

Location	Species Identified	Total Individuals	Shannon Index (H')	Simpson Index (1-D)	Evenness (E)
Tanah Datar	<i>Bactrocera dorsalis</i> , <i>Bactrocera carambolae</i>	678	0.077	0.029	0.111
Solok	<i>Bactrocera dorsalis</i> , <i>Bactrocera carambolae</i>	1,090	0.052	0.018	0.075
Agam	<i>Bactrocera dorsalis</i> , <i>Bactrocera umbrosa</i>	469	0.095	0.038	0.137
Padang Pariaman	<i>Bactrocera dorsalis</i> , <i>Bactrocera carambolae</i>	211	0.054	0.019	0.077

Note: Diversity indices represent descriptive values calculated from pooled abundance data per regency; therefore, no statistical comparison among locations was conducted.

Infestation Intensity among Chili Varieties

The assessment of plant and fruit infestation showed significant differences in infestation levels among the five local chili varieties. Plant infestation differed significantly among varieties ($p = 0.005$), indicating heterogeneous infestation patterns at the plant level. Keriting Bukittinggi, Aka, and Rawit showed relatively high plant infestation, whereas Kuhay showed the lowest plant infestation (21.7%). Fruit infestation also differed significantly among varieties ($p = 0.030$). Kopay, Aka, and Keriting Bukittinggi showed higher fruit infestation values, while Kuhay showed the lowest fruit infestation ($0.5 \pm 0.2\%$). Rawit showed an intermediate fruit infestation level and did not differ significantly from either the higher- or lower-infestation groups. A similar pattern was observed for infestation intensity, expressed as the proportion of infested fruits relative to the total number of fruits observed. Infestation intensity differed significantly among chili varieties ($p = 0.032$). Kuhay had the lowest infestation intensity (0.005 ± 0.002), indicating consistently low fruit

infestation under field conditions. In contrast, Kopay, Aka, and Keriting Bukittinggi showed higher infestation intensity values, whereas Rawit remained intermediate. Because sample size differed among varieties, particularly for Kopay, the infestation pattern of poorly represented varieties should be interpreted cautiously (Figure 4).

Infestation levels varied markedly among the surveyed regencies, indicating spatial heterogeneity in fruit fly pressure across chili-growing areas of West Sumatra. Solok Regency showed the highest infestation levels, with 88.00% of plants and 6.64% of fruits infested, whereas Padang Pariaman showed the lowest infestation levels, with 41.43% of plants and 1.83% of fruits infested. Agam and Tanah Datar showed intermediate levels of infestation. Across all regencies, plant infestation was consistently higher than fruit infestation. This pattern indicates that fruit fly activity was widely detected within chili fields, although the proportion of fruits showing infestation symptoms remained relatively lower. The higher infestation observed in Solok may be associated with local

agroecological conditions that favored fruit fly occurrence and infestation; however, further

environmental data would be needed to confirm the underlying factors (Figure 5).

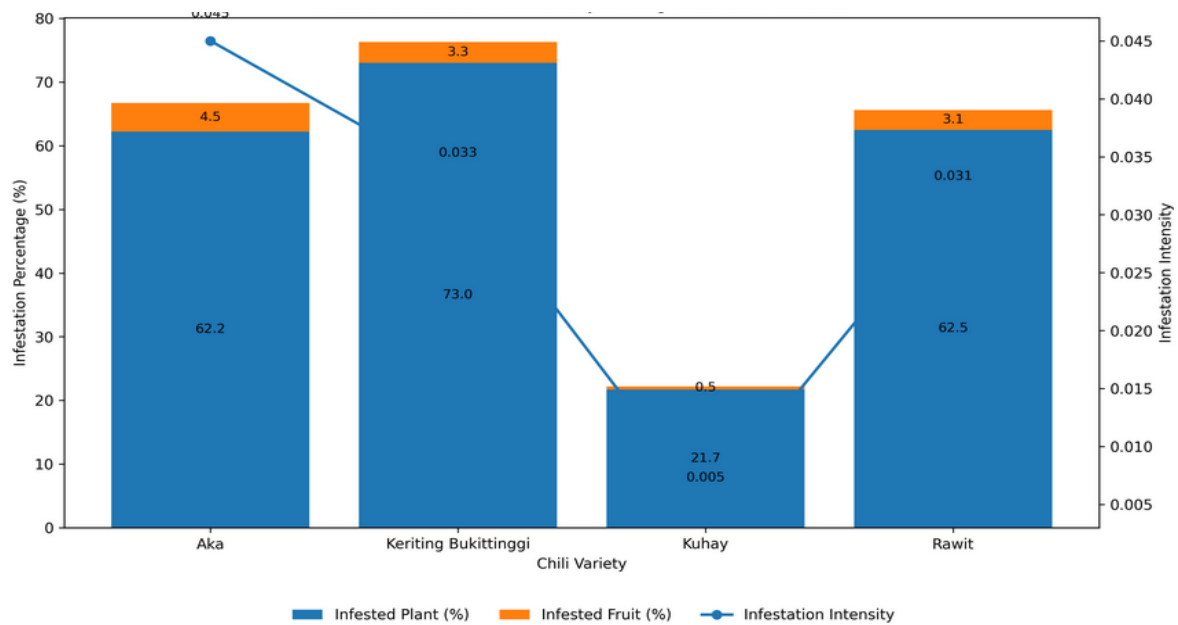


Figure 4. Plant infestation, fruit infestation, and infestation intensity of fruit flies among local chili varieties in West Sumatra, Indonesia

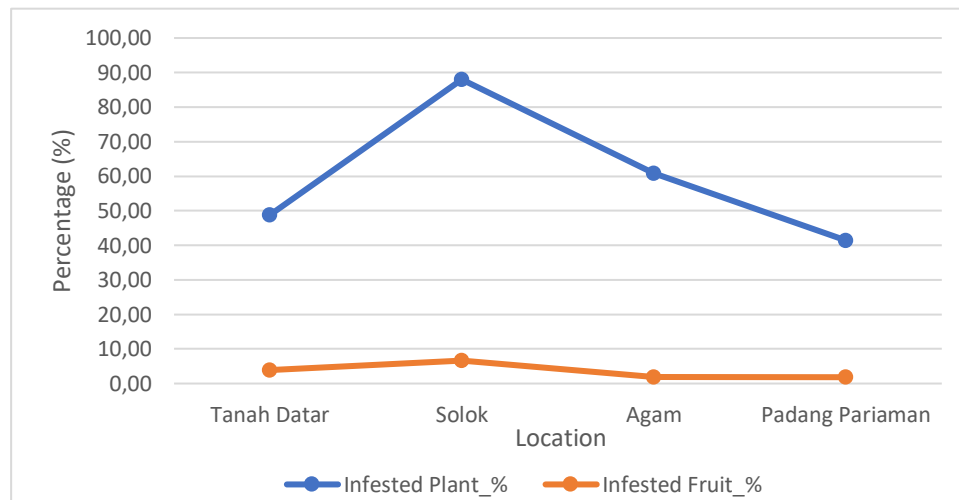


Figure 5. Spatial variation in plant and fruit infestation levels of chili by fruit flies across four regencies in West Sumatra, Indonesia

Principal Component Analysis and Cluster

Exploratory principal component analysis (PCA) showed variation among local chili varieties based on infestation characteristics. PC1 and PC2 explained 86.65% and 13.35% of the total variance, respectively, indicating that most of the variation was represented by PC1. Kopay was positioned on the positive side of PC1, suggesting a distinct

infestation pattern compared with the other varieties. In contrast, Kuhay was positioned on the negative side of both PC1 and PC2, corresponding to its relatively lower infestation levels. Aka and Keriting Bukittinggi were located in the upper quadrant of the ordination plot, indicating similar infestation characteristics, whereas Rawit occupied an intermediate position near the center of the

plot. Overall, the PCA provided an exploratory visualization of differential infestation

patterns among the evaluated local chili varieties (Figure 6).

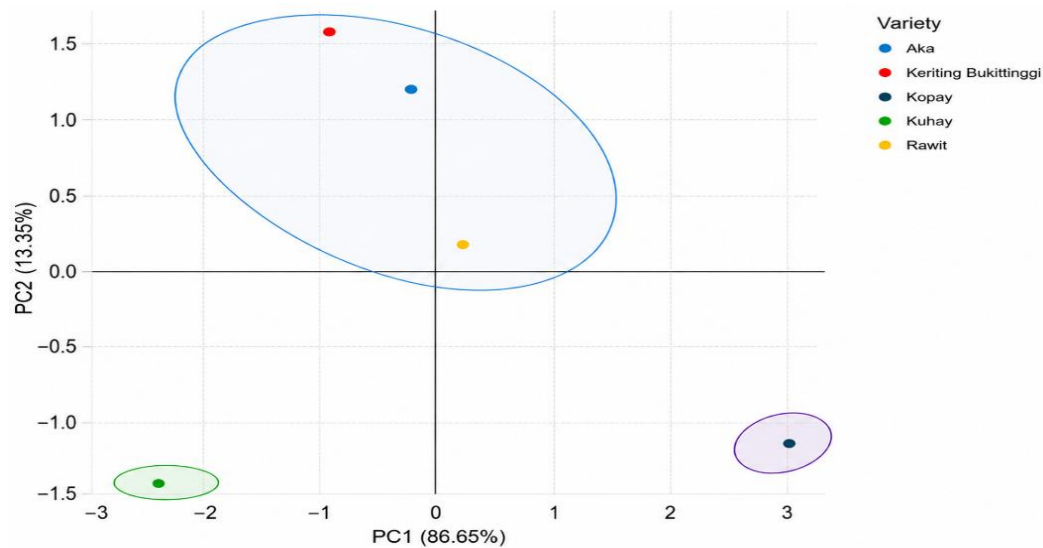


Figure 6. PCA ordination of local chili varieties based on plant infestation, fruit infestation, and infestation intensity

The exploratory clustering analysis grouped Aka, Keriting Bukittinggi, and Rawit within the same cluster, suggesting relatively similar infestation patterns among these varieties (Figure 7). In contrast, Kopay and Kuhay were positioned in separate clusters, indicating different infestation characteristics compared with the other varieties. Kuhay was located on the negative side of both PC1 and PC2, corresponding to its comparatively low

infestation levels. Meanwhile, Kopay was positioned on the positive side of PC1, reflecting a combination of moderate plant infestation and relatively high fruit infestation compared with the remaining varieties. Overall, the clustering pattern supported the PCA results by providing an exploratory visualization of similarity and separation among local chili varieties based on infestation parameters (Figure 7).

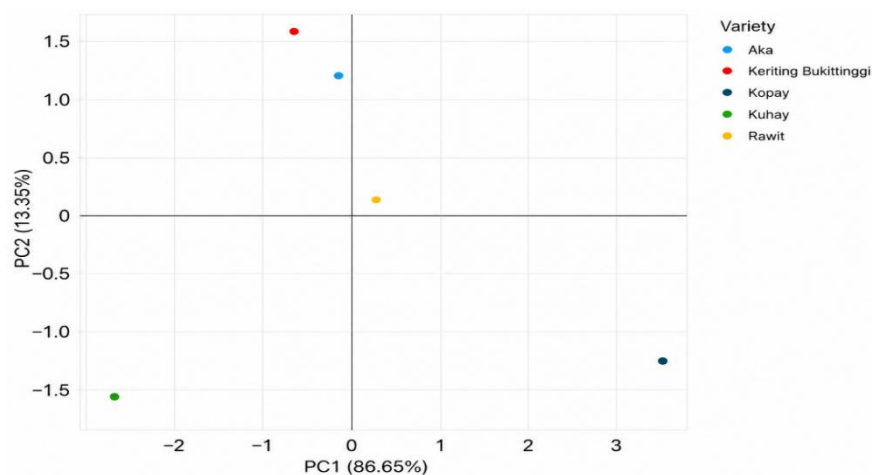


Figure 7. Exploratory clustering of local chili varieties based on fruit fly infestation parameters overlaid on PCA ordination

Discussion

The present study demonstrated that *B. dorsalis* overwhelmingly dominated fruit fly assemblages associated with chili agroecosystems in West Sumatra, accounting for 98.9% of the total trap captures (Table 2). Similar patterns of *B. dorsalis* dominance have been widely reported in tropical horticultural ecosystems due to its broad host range, high reproductive capacity, rapid development, and strong dispersal ability (Drew and Romig, 2013; Qin et al., 2018). These biological traits may explain why *B. dorsalis* was consistently recorded as the dominant species across all surveyed regencies in the present study. Infestation dynamics are unlikely to be driven by altitude alone but rather by interacting agroecological factors, including microclimatic variation, cropping intensity, and landscape structure, all of which can strongly influence fruit fly survival, reproduction, and host-location efficiency (Clarke et al., 2005; Vargas et al., 2015; Leblanc et al., 2019).

In addition, invasive populations of *B. dorsalis* may competitively suppress sympatric tephritid species through superior larval performance and more efficient exploitation of shared host resources (Ekesi et al., 2016; Hassani et al., 2016), which could be associated with the very low abundance of *B. carambolae* and *B. umbrosa* observed in the present study. However, the apparent predominance of *B. dorsalis* should be interpreted cautiously, as the use of methyl eugenol-baited traps may introduce species-specific sampling bias. Methyl eugenol is a highly effective parapheromone attractant for male *B. dorsalis* and related species within the *B. dorsalis* complex, often resulting in disproportionately high capture frequencies relative to non-responsive fruit fly species (Vargas et al., 2010). Therefore, trap captures may overestimate the relative abundance of methyl eugenol-responsive species and

underestimate the actual diversity of fruit fly communities in the field.

In contrast, *B. carambolae* and *B. umbrosa* were recorded at much lower abundance than *B. dorsalis*, representing only 0.9% and 0.2% of the total captures, respectively (Table 2). Although *B. carambolae* occasionally co-occurred with *B. dorsalis*, its abundance remained low, and it did not become dominant in any surveyed regency. Similar patterns have been reported in several ecological studies, where *B. carambolae* overlaps with *B. dorsalis* in ecological niches but may be suppressed under certain conditions (Drew and Romig, 2013; Clarke et al., 2019). Therefore, the sporadic occurrence of *B. carambolae* in this study may reflect limited coexistence in chili fields rather than a major contribution to the observed infestation pattern. In parallel, the occurrence of *B. umbrosa* was even more limited. This finding is consistent with previous reports showing that *B. umbrosa* primarily attacks cucurbit hosts rather than solanaceous crops (Drew and Romig, 2013; Muriithi et al., 2016). Consequently, its occasional presence in chili fields may be related to nearby alternative host plants rather than direct infestation of chili fruits.

The biodiversity indices calculated in this study further supported the observed dominance pattern. All surveyed regencies showed very low diversity, with H' values below 0.10, indicating simplified *Bactrocera* communities dominated by a single species. Among the surveyed locations, Agam exhibited slightly higher diversity and evenness values than the other regencies (Table 3). Low diversity values are commonly observed in simplified agroecosystems, where a few highly competitive pest species dominate available ecological niches (Magurran, 1988; Southwood and Henderson, 2009). This pattern may be associated with

greater environmental heterogeneity or the presence of diverse vegetation surrounding chili fields, which can provide alternative resources for different insect species. However, because vegetation structure and surrounding host plants were not directly quantified in this study, this explanation should be interpreted as a possible ecological factor rather than a confirmed causal mechanism.

Similarly, spatial variation in fruit fly abundance was observed across the study sites. Solok recorded the highest number of individuals captured, whereas Padang Pariaman showed the lowest trap catches (Table 2). Such variation in fruit fly populations has been widely documented in tropical agroecosystems and is typically influenced by environmental factors such as altitude, temperature, rainfall, and host plant availability (Clarke et al., 2005; Vargas et al., 2015; Ekesi et al., 2016). Agricultural management practices and landscape structure may also contribute to differences in fruit fly population density among locations.

The infestation results showed clear differences among local chili varieties, with Kuhay consistently exhibiting the lowest plant infestation, fruit infestation, and infestation intensity, whereas the others showed relatively higher infestation values (Figure 4). This pattern suggests that local chili varieties differ in their field susceptibility to fruit fly infestation. However, the lower infestation observed in Kuhay should be interpreted as lower field susceptibility rather than confirmed resistance, because this study did not directly evaluate resistance mechanisms such as fruit morphology, biochemical composition, volatile compounds, oviposition preference, or larval performance.

Previous studies have shown that chili genotypes can differ in their susceptibility to *B. dorsalis* infestation and that such

differences may be associated with antixenosis, antibiosis, and fruit morphochemical traits (Syamsudin et al., 2019; Syamsudin et al., 2022; Abdullah et al., 2023). Therefore, the consistently low infestation in Kuhay may indicate potential resistance-related traits that require further validation under controlled and balanced experimental conditions. In contrast, the relatively higher infestation observed in Keriting Bukittinggi and Aka may indicate greater field susceptibility under the surveyed conditions. The infestation pattern of Kopay should be interpreted cautiously, as this variety was represented by only a limited number of sampling fields, which may reduce the reliability of strong varietal comparisons.

Spatial infestation patterns also varied among regencies, with Solok showing the highest plant and fruit infestation levels, whereas Padang Pariaman showed the lowest levels (Figure 5). This finding indicates that fruit fly pressure was not uniform across chili-growing areas in West Sumatra. The higher infestation observed in Solok may be associated with local agroecological conditions that favor fruit fly occurrence and infestation, including host availability, cropping intensity, landscape structure, or microclimatic conditions. Nevertheless, because these environmental variables were not directly measured, the observed spatial variation should be interpreted cautiously and not attributed to a single factor. Across all regencies, plant infestation was consistently higher than fruit infestation (Figure 5), suggesting that fruit fly activity was widely detected within chili fields, although the proportion of fruits showing infestation symptoms remained relatively lower.

The PCA and clustering analyses provided exploratory support for differences in observed infestation patterns among local chili varieties (Figures 6 and 7). Aka, Keriting

Bukittinggi, and Rawit tended to group together, indicating relatively similar infestation patterns, whereas Kuhay and Kopay were positioned separately. The separation of Kuhay was consistent with its lower field infestation, while the position of Kopay reflected its relatively higher fruit infestation, but should be interpreted cautiously due to limited sample representation. A similar PCA-based differentiation between resistant and susceptible *Capsicum* accessions has been reported in fruit fly resistance studies that simultaneously evaluate morphological and biochemical characteristics (Syamsudin et al., 2019). These findings indicate that local chili germplasm may provide useful preliminary information for identifying varieties with lower field infestation. Further studies are needed before these varieties can be recommended as resistance sources for breeding or integrated pest management programs.

Conclusion

This study identified three fruit fly species associated with chili agroecosystems in West Sumatra, namely *Bactrocera dorsalis*, *B. carambolae*, and *B. umbrosa*. *Bactrocera dorsalis* overwhelmingly dominated the assemblages, resulting in low species diversity and evenness across regencies. Infestation levels differed among varieties, with Kuhay consistently showing the lowest plant, fruit, and overall infestation intensity. Aka, Keriting Bukittinggi, Rawit, and Kopay showed relatively higher infestation levels, although Kopay should be interpreted cautiously due to limited sample representation. These findings indicate differential field susceptibility among local chili varieties and suggest that low-infestation varieties such as Kuhay warrant further evaluation for integrated pest

management and resistance-oriented breeding programs.

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Declaration

Author contribution

Nguyen Phuoc Sang is the main contributor of this paper and the corresponding author. Novri Nelly, Reflinaldon, and Hidrayani are co-authors. All authors read and approved the final paper.

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Competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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