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Article

Infestation, Identification, and Comparative Development of Fruit Flies (*Bactrocera* spp.) on Two Varieties of Cayenne Pepper (*Capsicum frutescens* L.)

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Abstract: Cayenne pepper (*Capsicum frutescens* L.) is a high-value horticultural commodity in Indonesia whose productivity fluctuates annually due to climate variability, pest and disease infestations, and suboptimal harvest and post-harvest practices. Fruit flies (*Bactrocera* spp.) are among the most damaging pests, with their life cycle closely tied to fruit availability. This study aimed to identify fruit fly species infesting cayenne pepper, compare their development on two varieties (ORI 212 and Asmoro), and evaluate infestation rates and attack intensities in Tanjungrejo Village, Loceret District, Nganjuk Regency. Field observations and laboratory identifications were conducted using morphological keys. Two fruit fly species—*Bactrocera dorsalis* and *Bactrocera carambolae*—were identified. The highest infestation rate was recorded in ORI 212 at location I (94.64%), while the lowest was in Asmoro at location I (82.82%). Attack intensity followed a similar trend, with ORI 212 at location I reaching 24.06% and Asmoro at location I the lowest at 20.85%. These findings highlight varietal differences in susceptibility to fruit fly attacks, providing valuable data for targeted pest management strategies in cayenne pepper cultivation.

Keywords: Cayenne pepper, *Bactrocera*, identification, infestation intensity, varietal susceptibility.

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Introduction

Cayenne pepper (*Capsicum frutescens* L.) is an economically important horticultural commodity widely cultivated in Indonesia. It is valued for its pungency, colour, and nutritional content, making it a staple in both household and industrial food preparation. However, national cayenne pepper production fluctuates annually due to multiple constraints, including climate variability, pest and disease outbreaks, and suboptimal harvest and post-harvest handling practices. In Nganjuk Regency, East Java, production has shown a consistent decline from 130,830 quintals in 2019 to 43,471 quintals in 2023 (Badan Pusat Statistik, 2023).

Among the biotic constraints, fruit flies (*Bactrocera* spp., Diptera: Tephritidae) are a major pest, capable of causing significant yield and quality losses. Female fruit flies oviposit directly into immature or ripening fruit, and the resulting larvae feed internally, rendering the fruit unmarketable and predisposing it to secondary infections such as soft

rot caused by *Erwinia carotovora*. Under favourable environmental conditions and with susceptible host plants, yield losses may reach 50–75% (Susanto et al., 2018).

Varietal susceptibility is an important factor influencing pest incidence and damage severity. Fruit characteristics such as size, colour, firmness, and flesh thickness can affect host preference and oviposition behaviour of fruit flies (Syamsudin et al., 2022; Abdullah et al., 2023). In Tanjungrejo Village, Loceret District, farmers predominantly cultivate two cayenne pepper varieties: ORI 212 (a commercial hybrid) and Asmoro (an open-pollinated variety). However, comparative information on fruit fly infestation between these varieties in the local agroecosystem is limited.

This study aimed to (i) identify fruit fly species infesting cayenne pepper in the study area, (ii) compare the developmental duration of fruit flies on ORI 212 and Asmoro varieties, and (iii) determine the infestation rate and attack intensity on each variety. The findings are expected to provide baseline data for developing targeted and varietal-specific pest management strategies.

Materials and Methods

Study Site and Period

The study was conducted from December 2024 to February 2025 in Tanjungrejo Village, Loceret District, Nganjuk Regency, East Java, Indonesia, during the rainy season. Two cayenne pepper (*Capsicum frutescens* L.) varieties—ORI 212 and Asmoro—were observed in four field plots: ORI 212 (location I: 150.2 m²; location II: 164.5 m²) and Asmoro (location I: 209.6 m²; location II: 192.5 m²).

Sampling and Experimental Design

An observational field survey was employed. In each plot, 10% of the plants were randomly selected for monitoring. Infested fruits were collected based on visible symptoms, including oviposition punctures, darkened spots, and localized softening.

Laboratory Rearing and Identification

Infested fruits from each variety and location were placed in separate plastic containers and maintained at ambient laboratory conditions until adult fruit flies emerged. Specimens were examined under a USB Digital Microscope (1600× magnification) and identified to species level based on morphological characteristics of the wings, thorax, and abdomen using the key of Hudiwaku et al. (2022).

Fruit Fly Development Observation

Collected larvae were monitored daily until they reached the imago stage. Development time was recorded separately for each variety to compare larval–pupal–adult duration.

Infestation Rate and Attack Intensity

The **percentage of infested plants** was calculated as:
Infestation rate (%) = Number of infested plants per Total observed plants×100%. Attack intensity was determined using the scale of Sartika et al. (2022), where:
0 = no attack;
1 = light (1–24% damage);
2 = moderate (25–49%);
3 = heavy (50–70%);
4 = very heavy (>71%).

The **attack intensity** was calculated as: Attack intensity(%)=((∑(n×v))/N×V))×100% where n = number of plants in each damage category, v = category score, N = total plants observed, and V = highest category score.

Data Analysis

Data were summarised using descriptive statistics. Differences between varieties and locations were compared using mean values of infestation rates and attack intensities.

Results and Discussion

Two fruit fly species were identified from infested cayenne pepper fruits in Tanjungrejo Village: *Bactrocera dorsalis* (Hendel) and *Bactrocera carambolae* Drew & Hancock. Both species belong to the *Bactrocera* dorsalis complex and are known polyphagous pests with broad host ranges. Identification was confirmed using morphological keys, with diagnostic features including the 'T'-shaped abdominal pattern, wing costal band extension, and anterolateral corner shape of tergum IV. The presence of both species aligns with previous surveys in Java, where *B. dorsalis* and *B. carambolae* dominate *Capsicum* spp. infestations (Sahetapy et al., 2019). Their overlapping host preference may increase interspecific competition, potentially influencing field population dynamics.

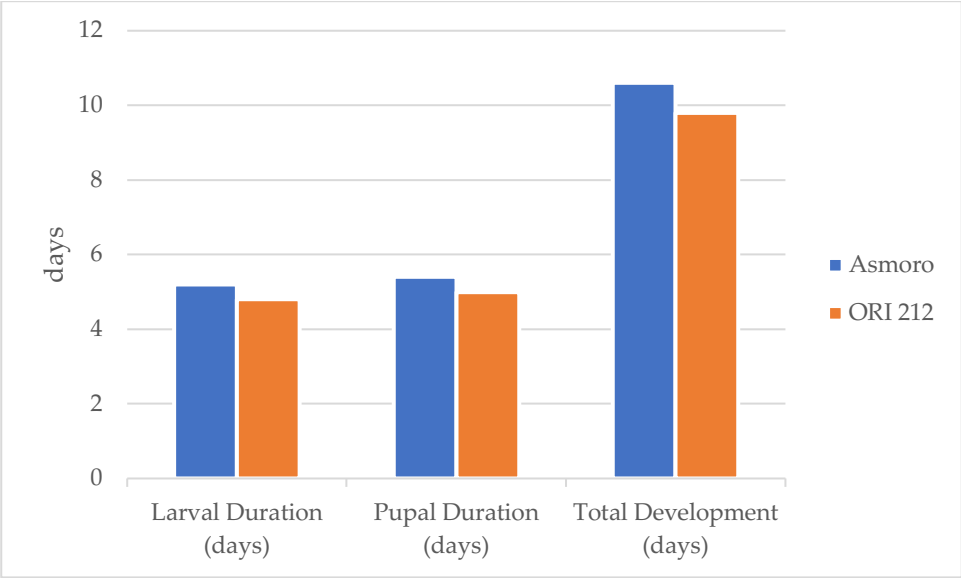

Figure 1. Development duration of fruitfly.

The development period from larva to adult varied slightly between varieties. On Asmoro, *Bactrocera* spp. completed development in an average of X days (Larva: Y days; Pupa: Z days), while on ORI 212, the duration averaged slightly shorter/longer (data from Tables 4.1 and 4.2). These differences may be linked to fruit physical characteristics such as thickness and firmness, which can influence larval feeding efficiency and pupation success (Budiani & Suksana, 2020) (Figure 1).

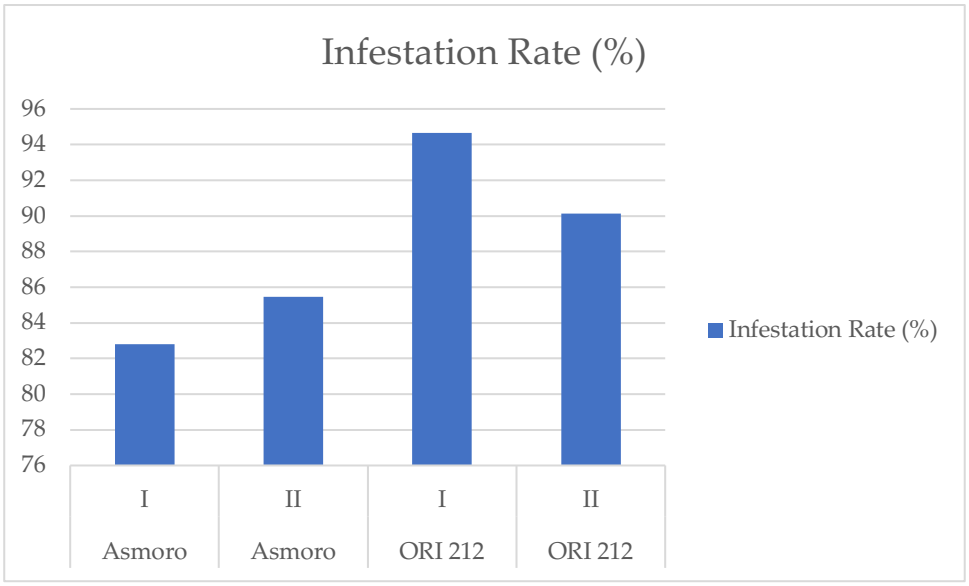

Figure 2. Infestation rate of fruit fly on two different varieties and field.

Infestation rates differed between varieties and locations (Table 4.3). The highest percentage of infested plants was recorded in ORI 212 at location I (94.64%), while the lowest occurred in Asmoro at location I (82.82%). The higher susceptibility of ORI 212 may be associated with its larger fruit size and thicker pericarp, which are more attractive for oviposition (Syamsudin et al., 2022).

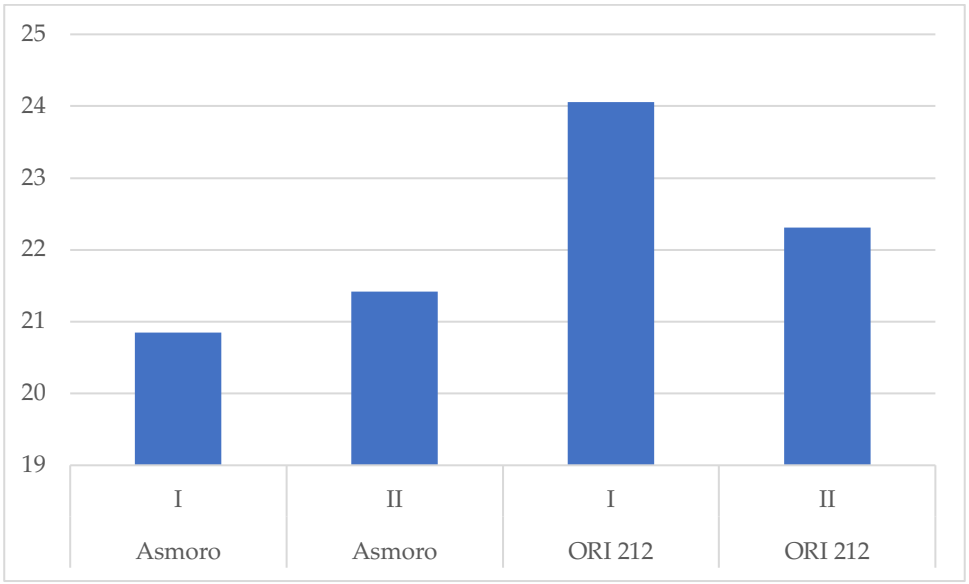

Figure 3. Attack intensity of fruitfly

Attack intensity patterns mirrored infestation rates (Table 4.4). The highest intensity occurred in ORI 212 at location I (24.06%), followed by Asmoro at location II, while the lowest was recorded in Asmoro at location I (20.85%). The variation may also be influenced by microenvironmental conditions, as location I for ORI 212 was situated near a river, potentially favouring higher humidity and thus greater fruit fly activity (Susanto et al., 2017).

This study demonstrates that varietal differences significantly influence fruit fly infestation levels and developmental duration. ORI 212 exhibited higher infestation rates and attack intensities compared to Asmoro, suggesting greater susceptibility due to its larger fruit size, thicker pericarp, and potentially more attractive volatile compounds for

oviposition. These findings are consistent with prior research indicating that physical and biochemical traits of host fruits affect fruit fly host selection and larval survival.

Microenvironmental factors also played a role. Plots located near water sources, such as rivers, recorded higher infestation, likely due to increased humidity favouring adult fruit fly activity. Such environmental influences suggest that site selection and field layout planning could be integrated into pest management strategies.

For sustainable control, integrated pest management (IPM) should combine resistant varietal selection, field sanitation, use of attract-and-kill traps, and conservation of natural enemies. Further research could focus on the biochemical profiling of different cayenne pepper varieties to identify key attractants for fruit flies, and on assessing the efficacy of biological control agents in local agroecosystems.

Conclusions

Two fruit fly species, *Bactrocera dorsalis* and *Bactrocera carambolae*, were identified as pests of cayenne pepper in Tanjungrejo Village, Nganjuk Regency. Infestation rates and attack intensities varied between varieties, with ORI 212 consistently showing higher susceptibility than Asmoro. The fastest larval-to-adult development occurred on ORI 212, suggesting that its fruit characteristics may favour fruit fly growth and reproduction. These results indicate that varietal selection plays an important role in managing fruit fly infestations. Incorporating resistant or less-preferred varieties such as Asmoro, combined with integrated pest management (IPM) measures—such as field sanitation, trap deployment, and conservation of natural enemies—can help reduce damage and improve cayenne pepper productivity in the region.

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