

PEST DISTRIBUTION PATTERN OF HYPOTHENEMUS HAMPEI IN ARABICA COFFEE PLANTATIONS

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Abstrak. This study aimed to analyze the distribution pattern of the pest *hypothenemus hampei* on arabica coffee plantations. This research was conducted in four arabica coffee plantations in Bener Meriah Regency. The location of arabica coffee plantations is determined based on three altitudes, namely 1300-1400 masl, 1400-1500 masl, and 1500-1600 masl. Observation of the intensity of the distribution of the pest *hypothenemus hampei* was carried out by making a mapping based on the level of attack and population level. Data on the distribution pattern of the pest *hypothenemus hampei* were analyzed using the binomial distribution index (K), variant relationship intensity (I), the green coefficient ($\sum x$), and the Morisita index ($I\delta$). The results showed that the value of $2 < K < 8$, the value of $I < 1$, the value of $\sum x > 1$, and the value of $I\delta < 1$. Therefore, the distribution pattern of the pest *hypothenemus hampei* was well clustered in arabica coffee plantations at an altitude of 1300-1600 masl.

Keywords:
Altitude;
Arabica Coffee;
Distribution Pattern;
Hypothenemus Hampei.

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INTRODUCTION

Arabica coffee is the type of coffee that is widely commercialized in the world. Coffee also consumes worldwide due to its organoleptic and stimulating properties and beneficial health effects (Rodrigues & Bragagnolo, 2013). One of the obstacles in coffee plantations is pest infestation. There are several types of pests that attack coffee plants, including coffee fruit borer (*Hypothenemus hampei*), stem borer (*Zeuzera sp.*), Branch borer (*Xylosandrus spp.*), Green lice (*Coccus viridis*), mealybugs (*Ferrisia virgata*), and *Antestiopsis thunbergii* (Meilin, et al., 2017).

The coffee fruit borer pest (*Hypothenemus hampei*) is a major pest of coffee plants that cause a lot of harvest loss in the coffee producer regions such as Indonesia, South America, and Southeast Asia (Vega, et al., 2009). The attacked coffee plant can suffer young fruit fall, decrease quality and quantity of harvest, and the coffee taste is a defect due to the bite mark of pest attack on coffees beans (Guadarrama, et al., 2019).

To find out the sampling method and the number of samples to obtain to observe the level of fruit borer pest attack, the distribution of this pest must be determined in advance. The results of in-depth research conducted by [Wiryadiputra \(2014\)](#) stated that the distribution of this pest in Arabica coffee plantations in Salvador follows a group (clustered) distribution, and it is in accordance with the negative Binomial law ([Pinard, et al., 2014](#)). However, the distribution type of fruit borer pests in Bener Meriah district has not been revealed, both in the spatial distribution and vertical distribution. The type distribution of a pest is very important to develop a control strategy in an integrated manner. Therefore, it is necessary to investigate the distribution patterns of Coffee fruit borer pest (*Hypothenemus hampei*), simultaneously measuring the level of damage caused by *Hypothenemus hampei* in Arabica coffee plantation in Bener Meriah. This study aims to determine the distribution pattern of *Hypothenemus hampei* in three areas based on altitude.

METHOD

In this study, the distribution pattern of the *Hypothenemus hampei* pest was carried out on the arabica coffee plantation at Bener Meriah district, with an altitude of 1300 - 1600 meters above sea level (masl). It was divided into three stations: Station 1 at altitude 1300 - 1400 masl, Station 2 at altitude 1400 - 1500 masl, and Station 3 at altitude 1500 - 1600 masl. As an observation plot, 400 coffee plants were used in each station with a uniform productive habitus, a regular planting system and fewer dead plants. The trees were observed for the pest population parameters, with a plot size of 20m x 20m at the predetermined stations.

The observation was conducted on four coffee branches located in the center of the tree. The determination of the four branches in each section followed the cardinal directions; the branches that lead to the north, east, south, and west. Observation of the pest attacks intensity was carried out by calculating the percentage of affected fruit on all fruits for each branch, with the formula:

$$I = (Bb/Bt) * 100\%$$

Information ([Wiryadiputra, 2014](#)):

I = intensity of attack

Bb = fruit attacked by pest/branch

Bt = total number of fruits/branches

Observations were conducted at the peak of the harvest period when some of the coffee fruit was still green and about 6 - 7 mm in diameter, and the seeds began to harden. This observation time was based on the time available and the presence of fruit borer pests. The fruit borer pest attack on Arabica coffee started around 2 - 3 weeks. For the Binomial distribution index (k), if the value is low and positive ($k < 2.0$), the level of aggregation or grouping is high; if $2.0 < k < 8.0$ means moderate aggregation; and if $k > 8.0$ means random or random distribution. To clarify the spatial

distribution pattern of fruit borer pests, mapping was carried out based on the level of attack and population level in Arabica coffee.

From the data obtained, the mean (x_r) and variance (s^2) are calculated with the following formula:

$$X_r = \sum x / n$$

Information (Southwood, 2013):

X_r = average sample

n = Number of samples taken

$\sum x$ = Data taken (level of attack and fruit borer pest population)

$$s^2 = \{ \sum (x^2) - \sum (x)^2 / n \} / (n - 1)$$

Information (Southwood, 2013):

s^2 = Variance

x^2 = Sample mean

$\sum x$ = Data taken (level of attack and fruit borer pest population)

n = Number of samples taken

$$k = (x^2) / (s^2 - x_r)$$

Information (Costa, et al., 2010):

k = Negative Binomial distribution index;

s^2 = Variance

x_r = Sample average

The relationship between variance and mean (I) can be explained if $I = 1$, it means the random spatial distribution; if $I < 1$, then the distribution is regular or uniform; and if $I > 1$, then the distribution is grouped (aggregate, contagious, clumped). For the Binomial distribution index (k), if the value is low and positive ($k < 2.0$), the level of aggregation or grouping is high; if $2.0 < k < 8.0$ means moderate aggregation; and if $k > 8.0$ means random distribution. To clarify the spatial distribution pattern of fruit borer pests, mapping was carried out based on the level of attack and the level of the population.

RESULTS

Based on research that has been conducted at three altitude levels, namely 1300 - 1400 masl, 1400 - 1500 masl, 1500 - 1600 masl, it is found that the distribution pattern of the *Hypothenemus hampei* is clustered. Presented in Figure 4.1 with a k value $<$ of 2 (grouped).

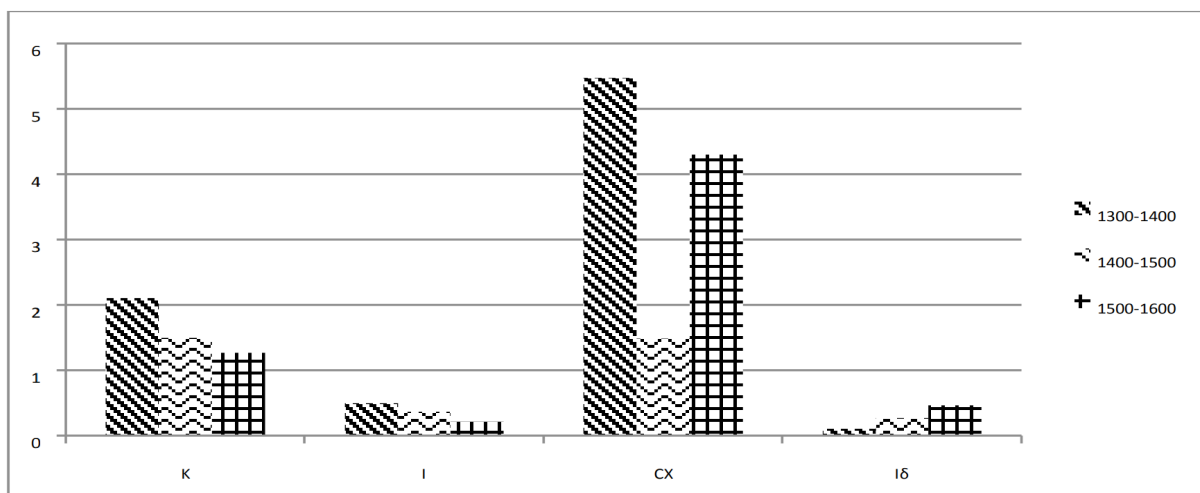


Fig 1. Binomial Distribution Index, Intensity of Variant Relationship, Green Coefficient, Morista Index

DISCUSSION

Distribution Pattern of *Hypothenemus Hampei* at Bener Meriah Coffee Plantation

Coffee plants dominate plantation in Bener Meriah. Coffee in Bener Meriah consists of several types; however, the types of coffee observed in this study are Arabica coffee. Arabica coffee production has decreased in the last seven years and one of the reasons for the decline is the increased spread of coffee fruit pests. It gnaws at the fruit flesh so the higher the pest spread, the higher the number of coffee fruit damaged. *Hypothenemus hampei* is a pest that lives on coffee fruits. Based on research carried out at three altitude levels (1300 - 1400 masl, 1400 - 1500 masl, and 1500 - 1600 masl), the distribution patterns of *Hypothenemus hampei* were clustered. The data processing uses four benchmarks: the relationship of mean and variance, Morisita's index, Green coefficient, and the binomial distribution index. The Green coefficient analysis results showed the value was far from 1; therefore, the classification level is not interpreted as optimal. This was in line with research by [Wiryadiputra \(2014\)](#), which stated the distribution pattern of the pest on Arabica coffee. Both attack and population levels did not appear significantly different from Robusta coffee, the clustered distribution.

Based on the results, it was found that the distribution pattern of the *Hypothenemus hampei* was clustered at three altitude levels (1300 - 1400 masl, 1400 - 1500 masl, 1500 - 1600 masl). Coffee pests have become a fairly common problem in coffee plants ([Acharya & Dhakal, 2014](#)). It was presented in Figure 1 with the value of $K < 2$ (clustered). Distribution of the *Hypothenemus hampei* most commonly found at an altitude of 1300 - 1400 m above sea level; thus, this altitude assumed to be a very good location for the growth of *Hypothenemus hampei*. The pest was also growing faster at lower altitudes, as explained by [Susnihti, et al. \(2017\)](#). At the height of 500 m above sea level, the insect took 25 days to develop. At an altitude 1200 m above sea level, it took 33 days to develop. It was similar to [Jaramillo, et al. \(2009\)](#), who

explained that the development of *H. hampei* was affected by temperature and the coffee fruit availability. *H. hampei* could live at 15°C - 35°C. The optimum temperature for the development of eggs was between 30°C - 32°C, and for the larvae, pupae, and adults were between 27°C - 30°C. The female insect could eat the fruit coffee between 20°C - 33°C; however, at 15°C and 35°C, the female insects could not bore the fruit or could bore the coffee fruit but did not lay eggs. In addition, it is necessary to manage soil nutrition as one of the most important agronomic practices for damage by stem borer pests (Thapa & Lantinga, 2016).

CONCLUSIONS AND SUGGESTIONS

Based on the results and discussion above, it can be concluded that the distribution pattern of *Hypothenemus hampei* in Bener Meriah coffee plantations was clustered (grouped) whether at an altitude 1300 - 1400 masl, 1400 - 1500 masl, or 1500 - 1600 masl. Moreover, most of the *Hypothenemus* pests were found at the first station, at an altitude of 1300 - 1400 masl. The data on the distribution pattern of the pest *hypothenemus hampei* is worth of $2 < K < 8$, the value of $I < 1$, the value of $\sum x > 1$, and the value of $I\delta < 1$. Therefore, the distribution pattern of the pest *hypothenemus hampei* was well clustered in arabica coffee plantations at an altitude of 1300-1600 masl.

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