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Hasil Penelitian

Coffee Berry Borer (*Hypothenemus hampei Ferr*.): **Symptoms, Distribution, and Management**

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ABSTRACT

Coffee farmers in Indonesia often face various challenges, including climate change, limited technology and knowledge, inadequate seed quality, and significant problems in cultivation, such as pest and disease attacks (Nadiawati et al., 2023). However, one of the most significant threats to their livelihood is the infestation of coffee borer pests (PBKo). The main culprit behind this decline is the pest known as Hypothenemus hampei Ferr. (Jaramillo et al., 2006). (Jaramillo et al., 2006). This mini-review provides crucial information regarding the symptoms, distribution, and techniques to reduce damage by CBB in the coffee plantation, aiming to prevent potential economic losses and ensure the financial stability of coffee farmers in Indonesia.

Keywords: *Hypothenemus hampei* Ferr., symptoms, distribution, control

A. Introduction

Coffee, a vital plantation product, plays a significant role in bolstering Indonesia's economy. As the fourth largest coffee producer globally, Indonesia's coffee plants are a key commodity, providing substantial economic benefits for foreign exchange. In 2010, Indonesia exported 433.6 thousand tons of coffee, with a foreign exchange value of US$814.3 million. This figure rose in 2017, with exports of 467.8 thousand tons and a foreign exchange value of US$1,187.16 million, as per Indonesian Coffee Statistics (Sari, 2023). The coffee industry in Indonesia is not just a business but a cornerstone of the nation's economy, making your work as coffee farmers and researchers crucial. Arabica coffee (*Coffea arabica* L.) is a plantation plant that originates from the mountainous forests of Ethiopia, Africa (Panggabean, 2011). This coffee plant belongs to the class Magnoliopsida, the subclass Asteridae, and the genus Coffea (Muharam & Sriwidodo, 2022). Arabica coffee typically thrives in cold and cool regions at 600-2000 meters above sea level altitudes. The best temperature for Arabica coffee growth is 18-26°C, which takes nine months from flowering to harvest. This plant requires annual rainfall between 1200-2000 mm, and the ideal temperature for its growth ranges from 15-24°C. It has an upright or small shrub tree shape, reaching a height of 5-6 meters with a trunk diameter of about 7 cm.

Arabica coffee farmers in Indonesia often encounter challenges such as climate change, technological constraints, limited knowledge, substandard seed quality, and prevalent issues in cultivation, such as pest and disease infestations (Nadiawati *et al.*, 2023). *Hypothenemus hampei* Ferr. is a coffee fruit borer pest that can lead to a decrease in both the quantity and quality of coffee fruits and is considered the primary pest causing economic harm by reducing the taste and production of coffee (Sari, 2023). This can lead to up to 80% losses in unmaintained plantations. This attack causes damage such as fruit development failure, a change in fruit colour to reddish-yellow, and eventual fall, resulting in decreased quantity and quality of coffee yields, particularly in taste and aroma (Soesanthy *et al.*, 2016).

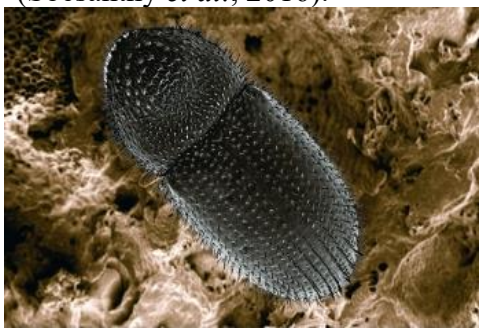

Figure 1. Image of adult *Hypothenemus hampei* Ferr.
(Source: https://www.cabidigitallibrary.org/ doi/ 10.1079/cabicompendium.51521)

B. Coffee Berry Borer Reproduction Cycle

The *Hypothenemus hampei* Ferr. undergoes complete metamorphosis through four stages: eggs, larvae, pupa, and adult insects. Female pests are larger than male beetles, with a length of about 1.7 mm and a width of 0.7 mm, while male beetles have a length of about 1.2 mm and a width of 0.6-0.7 mm. The female beetles make holes about 1 mm in diameter in the coffee fruit, usually at the end, to lay eggs. The eggs hatch within 5-9 days, the larvae undergo stages for 10-26 days, and pupae for 4-9 days. The development of this insect takes 25 days at an altitude of 500 m above sea level and 33 days at an altitude of 1200 m (Hamilton, 2019). Female insects have an average lifespan of 156 days, while male insects live a maximum of 103 days. A Female *Hypothenemus hampei* Ferr. enters the coffee beans by making a hole and usually lays about 30-50 eggs. The eggs hatch into larvae that gnaw on coffee beans. After that, the larvae enter the pupal stage inside the seed and eventually become an adult insect or beetle that emerges from the seed.

The mating process between male and female insects occurs inside the coffee fruit, with some females then flying to other fruits to lay eggs again. At the end of the coffee harvest season, the insect population of *Hypothenemus hampei* Ferr begins to decline due to limited food availability. Hypothenemus hampei Ferr. Populations tend to be dominated by females because their lifespan is longer than that of male insects (Jaramillo *et al*., 2006).

C. The environmental factors affecting *Hypothenemus hampei* Ferr. dispersal

The Arabica coffee species is the most sensitive plant to the pest attack. The abiotic factors affecting the coffee berry corer life cycle are temperature (20-30°C) and humidity (90%-95%). The optimal temperature for egg development is between 30ºC to 32ºC, while for larvae, pupa, and adults, the optimal temperature is between 27ºC and 30ºC. Female insects can pry coffee fruits at temperatures between 20ºC to 33ºC. At temperatures below 15ºC or above 35ºC, female insects fail to drill coffee berries or can drill them but not lay eggs. Under certain conditions, the ratio of the number of female and male insects can reach 500:1. Male insect *Hypothenemus hampei* Ferr. It has no flying ability and usually lives in seed burrows—an average lifespan of about 156 days. Female insects usually make afternoon flights between 16.00 and 18.00 (Baker *et al*., 1992).

D. Symptoms of *Hypothenemus hampei* Ferr. attack

According to Hamilton (2019), the insect typically infests coffee fruits with hardened endosperm but can also attack soft fruits. Coffee fruits with soft beans are usually only visited for food and then abandoned. Fruits affected in this way do not develop, turn reddish-yellow, and eventually fall off. Attacking fruits with hardened seeds can reduce coffee quality.

Deformed coffee beans affect the chemical composition, particularly caffeine and reducing sugars, and influence the coffee taste.

Figure 2. The coffee berries with CBB attack (*left*) and penetration hole generates by CBB in immature coffee berries and mature coffee cherries (*middle* and *right*)
(Source: https;//rwenzorimountaincoffee.org/page/show/11#2.-coffee-berry-borer)

The coffee berry borer (*Hypothenemus hampei* Ferr.) enters the coffee fruit by creating a hole near the bottom. Infestation in young coffee fruits leads to premature fruit drop, while in older fruits, the attack causes deformed coffee beans with holes and reduces their quality. The eggs of these insects only develop in mature, hard coffee beans. The boring insects may die prematurely without enough food inside the beans. After harvesting, coffee beans provide an ideal environment for these pests to breed, with up to 75 pests found in a single coffee bean.

Hypothenemus hampei Ferr. is a pest that attacks young coffee fruits, leading to fruit fall. In older fruits, this pest causes coffee beans to become deformed with holes, leading to low quality. This pest is known to consume and reproduce inside coffee fruits.

Female pests enter the coffee fruit by creating a hole in the tip of the fruit and multiplying it. They begin damaging the coffee beans as the beans start forming endosperms. The female lays eggs on coffee fruits that already have hard endosperms. When the fruit is ripe, the female makes a small hole in the outer skin of the coffee fruit (mesocarp) to lay the eggs.

E. Distribution of *Hypothenemus hampei* Ferr.

Coffee fruit borer insect (*Hypothenemus hampei* Ferr.) originates from Africa and later spread to Brazil, Guatemala, Asia including India, Indonesia, and some Pacific islands. This insect only attacks coffee fruits. This pest is known as coffee fruit powder or **coffee berry borer (CBB)**, belonging to the order Coleoptera, family Scolytidae, and is widespread in Indonesia. The *Hypothenemus hampei* Ferr. appears shiny black or brown-black colour.

Without proper control, these attacks can spread throughout the coffee plantation. In the old, dried coffee fruit left behind after harvest, the population of *Hypothenemus hampei* Ferr. can reach more than 100 heads.

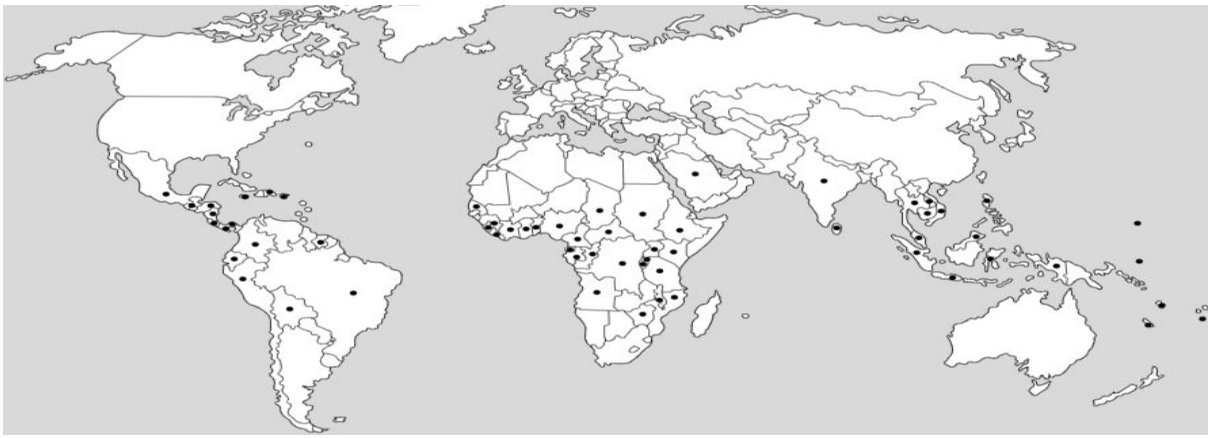

Figure 3. Countries where the CBB was found (dots indicate the affected areas) (Source: https;//rwenzorimountaincoffee.org/page/show/11#2.-coffee-berry-borer)

Based on the phenology of fertilisation of coffee plants, the management strategy of *Hypothenemus hampei* Ferr. It can vary between regions due to differences in place altitude, rainfall, temperature, soil type, coffee varieties, and agronomic practices. *Hypothenemus hampei* Ferr. tend to like coffee plants that grow lush with dark shade. This condition seems to be related to the origin of this pest from Africa, where it attacks wild coffee plants under humid tropical forests. Similar conditions were also seen in Brazil, where *Hypothenemus hampei* Ferr's heavy attack.

It usually occurs in coffee plantations that grow in heavy shade and foggy conditions, so the air humidity is quite high (https://rwenzori mountaincoffee.org/page/show/11).

F. Control of *Hypothenemus hampei* Ferr.

Pest control of *Hypothenemus hampei* Ferr. has been carried out and is considered effective, namely in terms of biology, chemistry, maintenance of sanitation in the plantation, and technical culture (Baker, 1992).

1. Biological Control
   a. Control with predatory insects and parasitoids
   Hypothenemus hampei Ferr has natural enemies of the predator group *Dindymus rubiginous*, the parasitoid group *Cephalonomia stephanoderis*, *Prorops nasuta* (Hymenoptera: Bethylidae), *Phymastichus coffea* (Hymenoptera: Eulophidae), and *Heterospilus coffeicola* (Hymenoptera: Braconidae), a group of nematodes: *Heterorhabditis* sp., *Penagrolaimus* sp., bacterial group: *Bacillus thuringiensis* and fungal group: *Beuveria bassiana*, *Paecilomyces fumosoroseus* (Jaramillo *et al*., 2006).
   b. The use of Entomopathogenic fungi
   The use of the fungus *Beauveria bassiana*, which is pathogenic to insects, *Hypothenemus hampei* Ferr, has resulted in the insect's death by 80%. Applying *Beauveria bassiana* fungus in the field with a spore concentration of 5 x 106/ml per millilitre caused the death rate of coffee fruit borer pests to reach 25.65% (Baker, 1992).
2. Technical culture control
   Breaking the life cycle of coffee fruit borer (*Hypothenemus hampei* Ferr.) is when picking all ripe fruits attacked by the pest 15-30 days before the big harvest. Another way that can be done is *lelesan*, by picking up all coffee fruits that fall on the ground, both infested and uninfested (Girsang *et al*., 2021).
   Poison or loot is also one way to control pests, namely by picking all the fruits on the tree at the end of the harvest so that it can reduce the intensity of the *Hypothenemus hampei* Ferr. attack. Control with sanitation is also effective in reducing the symptoms of pest attacks (Sari, 2023).
3. Pruning
   Coffee plantations with too close shade or lack of shade can support the development of Hypothenemus hampei Ferr pests. 5 times more and faster (Soesanthy *et al*., 2016). Coffee maintenance activities include embroidery, weed control, fertilisation, pruning, and pest and disease control (Jaramillo *et al*., 2006). Applying plant cultivation techniques is one of the important things that can affect coffee production. To increase optimal coffee plant production, it is necessary to carry out pruning techniques properly and correctly (Febrina *et al*., 2016). Pruning is a regular technical culture activity that forms a crown, removes plant parts infested with pests and diseases, removes water shoots, and improves air circulation (Jaramillo, 2006). Pruning is done on coffee and shade plants to prevent high humidity and overly dark planting conditions, which are conducive to developing *Hypothenemus hampei* Ferr. (Sari, 2023). Pruning techniques can also be used on shade plants because coffee plants require insufficient light (C3), and the amount of

sunlight absorbed affects the plant's physiological processes. Based on the description above, special attention is needed to coffee plant cultivation techniques, including pruning techniques.

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