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Attack Intensity of Coffee Berry Borer Hypothenemus Hampei Ferr at Different Altitudes in Simalungun Regency and Control Efforts Using Attractants

Rosmaria Girsang[1], Mei Linda Sipayung[2], Warlinson Girsang[3*], Meylida Nurrachmani[3], Tri Astuti[4], Surya Bambang Yudoyono[5], Ahmad Husin[5]

[1] Agrotechnology Study Program, Universitas Pembangunan Pancabudi Medan, Indonesia.
[2] Agribisnis Study Program, Universitas Darma Agung Medan, Indonesia.
[3] Agrotechnology Study Program, Universitas Simalungun Pematangsiantar, Indonesia.
[4] Forestry Study Program, Universitas Simalungun Pematangsiantar, Indonesia.
[5] Graduate of the Agrotechnology, Indonesia.

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Corresponding Author:
Warlinson Girsang
warlinsongirsang@gmail.com

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Abstract: The research was carried out in people's coffee plantations at 4 locations at different altitudes in Simalungun Regency. The aim of the research was to determine the intensity of attacks by the coffee berry borer Hypothenemus hampei Ferr on land at different altitudes, and to determine the effectiveness of synthetic attractant traps to control it. The research method used a series design (randomized design series groups), which was carried out on coffee plantations at altitudes of 550, 850, 1,000 and 1,150 meters above sea level. At each plantation location, in an effort to control Hypothenemus hampei Ferr attacks, 3 (three) types of synthetic attractant traps were installed: Hypotan 500 SL, Koptan and Atrakop 500 L. The results of the research showed that the intensity of Hypothenemus hampei Ferr attacks tended to decrease in coffee plantation locations. higher above sea level and vice versa. The attractant types Hypotan 500 SL, Koptan and Atrakop 500 L showed no significant difference in effectiveness for trapping the coffee berry borer Hypothenemus hampei Ferr. However, these 3 types of attractants have not been able to reduce the intensity of attacks from puso, heavy and moderate categories to light attack categories.

Keywords: Altitude; Attack intensity; Attractant; Coffee Berry Borer

Introduction

In Simalungun Regency there are 11 sub-districts that cultivate coffee plants at different heights. The eleven sub-districts are Girsang Sipangan Bolon District, Sidamanik District, Pematang Sidamanik District, Raya District, Dolog Masagal District, Purba District, Silau Kahean District, Silimakuta District, Pamatang Silimakuta District, Dolok Silau District and Panei District (BPS, 2019). Simalungun Regency is the second largest coffee producer after North Tapanuli Regency (Saragih, 2019; Tambunsaribu, 2018; Winarno & Perangin-angin, 2020). One type of coffee that is widely developed by farmers in Simalungun Regency is Arabica coffee (*Coffea arabica* L.). Arabica coffee has relatively higher quality and price compared to other types of coffee (Siahaan, 2008; Simbolon, 2023). If cultivated well, Arabica coffee usually starts producing at the age of 2.5 to 3 years, depending on the climate and soil fertility. At the age of 7 to 9 years, is the peak of Arabica coffee production. At this age, Arabica coffee production averages 5 to 15 quintals of rice coffee per hectare per year. If plantations are managed intensively, production can reach 20 quintals/ha/year (Najiyati & Danarti, 2004).

The main problem with coffee plantations in Indonesia is low productivity and product quality that does not meet standards. The low productivity of Indonesian coffee is mainly due to suboptimal plant cultivation (Adriani et al., 2020; Zaitunah et al., 2021).

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Cultivation aspects that need attention include suitability of the climate in the planting area, use of superior seeds, plant care, fertilization and control of plant pest organisms.

One of the plant pest organisms that always harms coffee plantations is the berry borer attack caused by *Hypothenemus hampei* Ferr (Pérez et al., 2005). These pest insects use coffee berry and beans as shelter, lay eggs, eat, reproduce and metamorphose. Female coffee berry borer beetles make holes which usually start at the tip of the coffee fruit when they are about to lay eggs. After laying eggs, the female beetle will come out of the fruit. The eggs that hatch into larvae will bore and damage the seeds. The characteristics of infected fruit are that there is a hole about 1 mm in diameter at the end. If part of the seed is broken, it can be seen that the seed has been crushed to the inside and causes the seed to blacken and rot. Bean damage caused by this pest reduces the quality of the taste and aroma of the coffee produced (Firman, 2017).

Coffee berry borer in Indonesia is evenly distributed in almost all coffee plantation areas (Efrata et al., 2023). Yield losses due to attacks vary depending on plant management conditions. On plantations where no control measures are taken, coffee berry borer attack can reach 100 percent (Barrera, 2008). The height of the coffee cultivation area influences the development of the pest *Hypothenemus hampei* Ferr (Johnson et al., 2020). In gardens with an altitude of 400 – 1,000 m above sea level, coffee plants can experience heavy attacks. Meanwhile, at an altitude of 1,500 m above sea level, there were no significant attacks.

Coffee berry borer pest attacks are spread throughout all coffee producing sub-districts (Girsang et al., 2018) with an attack intensity reaching 51.6 percent (severe attack category). The widespread spread of pests and the high intensity of attacks they cause (Skendžić et al., 2021). This is because farmers generally do not make control efforts. Also in cultivation practices, most coffee farmers in Simalungun Regency do not plant shade trees. In fact, the presence of protective trees can reduce the intensity of coffee berry borer attacks (Cowal et al., 2023; Escobar-Ramírez et al., 2019; Girsang, 2021). The presence of protective trees influences the planting agroecosystem and plays a role in increasing existing biodiversity.

To successfully control coffee berry borer, it is recommended to implement an integrated pest control system. Namely by combining various control methods that make it possible to prevent or reduce the intensity of attacks. For example, planting in agroecosystems according to the conditions for growing coffee, carrying out garden sanitation, implementing good technical culture, using biological control agents and using attractant traps (Siregar, 2016). The facts on the ground are that farmers are relatively unable to control coffee berry borer pests in Simalungun Regency due to various limitations. Controlling using attractant traps, coffee farmers in Simalungun Regency are still not familiar with or use them. The use and function of attractants as control of coffee berry borer pests is still not widely known by coffee farmers.

Based on the description above, the author conducted research to determine differences in the intensity of attacks by coffee berry borer pests on coffee cultivation planted at different altitudes, as well as conducting tests to determine the effectiveness of attractant compounds in controlling attacks by coffee berry borer pests.

Method

The research was carried out from July to August 2021 in people's coffee plantations at 4 locations with different altitudes. Representing an altitude of 550 m above sea level, research was conducted in Nagori Batu Duapuluh (Panei District). Representing an altitude of 850 m above sea level, the research was set in Hapoltakan (Raya District). Representing a location with an altitude of 1,000 m above sea level, the research was conducted in Nagori Raya Usang (Dolog Masagal District), and representing a location with an altitude of 1,150 m above sea level, the research was set in Nagori Simpang Hinalang (Purba District).

To support the implementation of the research, tools were used, including: plastic bottles packed with mineral water, measuring tape, camera, magnifying glass, *hand tally counter*, tweezers, tie wire, cutting pliers, *cutter knife*, syringe, bamboo and writing tools. The research materials consisted of: Arabica variety coffee plants (*Coffea arabica* L.) aged ± 8 - 9 years after planting, soap solution, water and synthetic attractant brand names: *Hypotan* 500 SL, *Koptan* and *Antrakop* 500 L.

The research method uses a series design (*randomized design series groups*), carried out in the form of a field survey. The land surveyed was the land of coffee farmers who planted Arabica coffee with relatively similar agronomic practices. The planting distances at the four plantation locations were not exactly the same. Coffee plantations on land 550 m above sea level use a planting distance of 2m x 2m. Gardens at an altitude of 850 m above sea level and 1,000 m above sea level use a planting distance of 2.5m x 2m and gardens at an altitude of 1,150 m above sea level use a planting distance of 2.5m x 2.5m. Farmers carry out plant maintenance by weeding around the trees at least 6 times a year, depending on the density of the weeds growing. Likewise, farmers remove unproductive shoots and twigs depending on their needs. Farmers only fertilize their plants twice a year using Ponska fertilizer at a dose of 5 - 8 grams per plant each. Each research area was divided into 4 plots by providing dividing ropes. In each plot, the number of existing coffee plant populations was counted and 10% of the population was used as sample plants which were applied randomly in a regular manner.

To determine the intensity of coffee berry borer attacks before control, ripe fruit was harvested on each sample plant from each predetermined group (replication). *Ripe cherry* coffee berries are harvested and placed in plastic bags and labeled. The harvested fruit is visually observed one by one to see whether there is a coffee berry borer attack or not. The criteria for infected fruit are that the seeds have holes in the *disc area* and if they are cut open, the seeds will rot and turn black. Infected seeds and healthy seeds are separated. The attack intensity is calculated using the formula: $Is = \{A/(A+B)\} \times 100\%$ (Is = attack intensity, A = number of infected seeds, and B = number of healthy seeds). Data on the intensity of coffee berry borer attacks from each sample plant from each replication (group) were added up and averaged.

After calculating the intensity of attacks by coffee berry borers at the start of the research, attractant traps were then installed which aimed to reduce attacks by coffee berry borers. The attractant tested was a synthetic attractant with the trade names *Hypotan* 500 SL, *Koptan* , and *Atrakop* 500 L. The attractant trap container used mineral water bottle packaging. A hole is made in the side of the bottle using a knife with a length of 6 cm and a width of 5 cm. Then, fill the mineral water bottle with soap solution with the water level ± 5 cm from the bottom of the bottle. Shachet packaging attractant compound is hung in the middle of the bottle slightly below the side hole that has been made. Then the bottle packaging is labeled with a treatment code. In each plot or replication of the experiment, the 3 trap bottles were placed and hung on a 1 meter bamboo pole using a wire. The trap was placed right in the middle of the plot (replication). The traps that have been installed are controlled periodically, so that no rainwater enters and affects the effectiveness of the attractant compound.

During the study, attractant installation was carried out twice with an interval of 1 month. After 1 month of installing the first attractant, then replace the installation of the second attractant application, with new attractant material. Harvesting of coffee cherries is carried out every 2 weeks for eight weeks after trap installation. In addition to calculating the intensity of coffee berry borer attacks before the attractant was installed, the effectiveness of the attractant in trapping the coffee berry borer and the types of non-target insects trapped by the attractant were also observed, as well as the intensity of *Hypothenemus hampei* Ferr attacks after the attractant was installed.

Result and Discussion

Hypothenemus hampei Ferr Attacks Before Attractant Application

Coffee berry borer attacks on coffee plantations at different heights before control efforts using attractant compounds are shown in table 1.

Table 1. Test of differences in average attack intensity ***of*** *Hypothenemus hampei* Ferr on coffee plantations at different heights before control efforts

Height of Place (m above sea level)	Average Intensity of Coffee berry borer Attacks (%)		Attack Category
550	94.75	a	Puso
850	72.26	b	Heavy
1,000	62.02	c	Heavy
1,150	39.48	d	Currently

Note: Numbers followed by different letter notations indicate significant differences at the 5% level.

From Table 1 it is known that before installing the attractant, the intensity of coffee berry borer attacks on coffee plantations at an altitude of 550 m above sea level reached 94.75% (puso attack). At an altitude of 850 m above sea level the intensity reaches 72.26% (severe attack). On plantation land with an altitude of 1,000 m above sea level, the attack intensity reached 62.02% (severe attacks). Meanwhile, on land at an altitude of 1,150 m above sea level, the attack intensity was only 31.50% (moderate attack). The criteria for the severity of the attack are guided by the Directorate of Food Crop Protection (2018).

On land at an altitude of 550 m above sea level, before installation of the attractant, the intensity of attack by the puso category of coffee berry borer was obtained . This is thought to be influenced by a mismatch in the growing conditions for the coffee plant itself. Wulandari et al. (2022) stated that coffee plants grow optimally at an altitude of 900 - 1,800 m above sea level with a temperature of 15-25%. Coffee plants planted at the appropriate height are healthier, so they are able to tolerate pest attacks. Land at an altitude of <600 m above sea level is not recommended for planting coffee because it is susceptible to pest attack. In lower altitudes, the life cycle of the coffee berry borer beetle takes place more quickly (Siregar, 2016), so it is possible for a faster population increase.

Different things can be seen in coffee plantations at altitudes of 1,000 and 1,150 m above sea level, where the intensity of coffee berry borer attacks is in the medium category. Wiryadiputra (2007) stated that the intensity of coffee berry borer attacks will be lower in areas with an altitude of more than 1,100 m above sea level. From the results of measurements of temperature, air humidity and the number of rainy days, it is known that at an altitude of 550 m above sea level, the average temperature is around 22.55 ^{0} C, the average air humidity is around 80% and the average rainy day is 16 days a month. At an altitude of 850 m above sea level and 1,000 m above sea level, the average temperature is around 20.64 ^{0} C, the average humidity is 85% and the average rainy days are 18 days a month. At an altitude of 1,150 m above sea level, the average temperature is around 19.25 ^{0} C, the average air humidity is around 90% and the average rainy day is 19 days a month. Aziz et al. (2018) stated that the intensity of coffee berry borer attacks is influenced by air temperature, humidity and elevation. At higher altitudes, the air temperature is lower causing the development of coffee berry borers to relatively decrease (Constantino et al., 2021; Mustari et al., 2021).

Effectiveness of Attractants Trapping Hyphothenemus hampei Ferr

Data on the number of coffee berry borers trapped during the 56 days of the study were obtained by adding up the adults trapped at the time of observation at 7, 14, 21, 28, 35, 42, 49 and 56 days after application of the attractant. From the results of the combined variance analysis, it was discovered that the number of trapped *Hyphothenemus hampei* Ferr imago differed significantly based on altitude. Meanwhile, the treatment of the 3 types of attractants tested did not show a significant difference in trapping coffee berry borer insects. The interaction of altitude with the type of attractant also did not affect the number of *Hyphothenemus hampei* Ferr who is trapped. To find out the differences between each treatment, a mean difference test was carried out using the Least Significant Difference Test (BNT), the results of which are as shown in Table 2.

From table 2 it is known that the total number of coffee berry borer insects trapped during the 56 days of research on land at an altitude of 550 m above sea level reached 2,276 individuals, not significantly different from the land at an altitude of 850 m above sea level (capable of trapping 2,102 individuals), but significantly different from the total number of insects Coffee berry borers were trapped on land at an altitude of 1,000 m above sea level (trapping 5,250 individuals) and on land at an altitude of 1,150 m above sea level (trapping 1,932 individuals).

Table 2. Test results for differences in the average number of *Hyphothenemus to* Ferr which are trapped by attractants at various heights of coffee plantations

Treatment	Total Hyphothenemus hampei Ferr. which is trapped (tail)	
Height of place (m above sea level):		
550	2,276	a
850	2,102	a
1,000	5,250	b
1,150	1,392	c
Attractant:		
Hypotan 500 SL	3,763	a
Coptan	3,390	a
Atrakop 500 SL	3,867	a

Note: Numbers followed by different letter notations for the same treatment indicate that they are significantly different at the 5% level

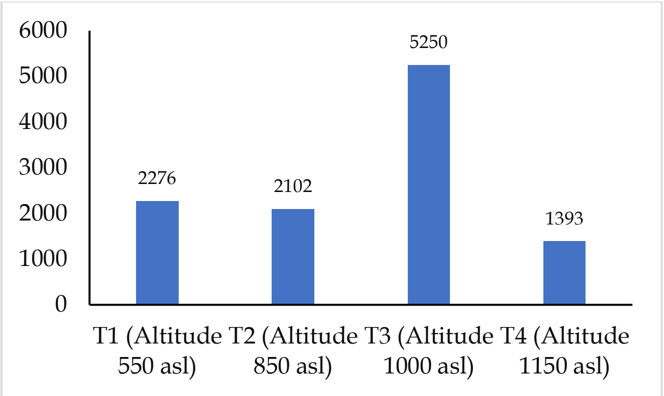

Figure 1. Graph of the number of coffee berry borer insects trapped on land at different heights.

Figure 1 shows that on land at altitudes of 550, 850 and 1,000 m above sea level, respectively, the number of coffee berry borer insects trapped was greater than those trapped on land 1,150 m above sea level. This is because, before control using attractant traps, the intensity of attacks at the three lower altitudes was in the puso attack category and the heavy attack category.

On coffee plantations at an altitude of 550 m above sea level, the intensity of coffee berry borer attacks was 94.75%. On coffee plantations at an altitude of 850 m above sea level, the attack intensity was 62.26% and the intensity of attacks on coffee plantations at an altitude of 1,000 m above sea level was 72.26%. In contrast to coffee plantations at an altitude of 1,150 m above sea level, the attack intensity was lower, namely only 31.50%. Thus, it is logical that on land at altitudes of 550, 850 and 1,000 m above sea level, the total number of trapped coffee berry borer insects can be obtained. far more than those trapped in coffee plantations at an altitude of 1,150 m above sea level.

From table 2 it can be seen that the number of coffee berry borer imago trapped by the attractants Hypotan 500 SL (3,763 individuals), Koptan (3,390 individuals) and Atrakop 500 SL (3,867 individuals). The ability of the three attractants to trap coffee berry borer pests in statistical analysis not significantly different. This is because the three types of attractant have relatively the same active ingredient, namely 500 gr/liter ethanol and the same volume in each sachet , namely 10 ml. Volatile ethanol released into the air will then attract coffee berry borer pest insects to come closer and enter the trap (Aristizábal et al., 2023). The soap solution that is already in the trap will speed up the death of the trapped imago.

Number and Types of Other Insects Not Targeted by Attractants

During 8 observations, other types of non-target insects trapped by Attractant on each coffee plantation at different altitudes consisted of 10 species and 7 orders, namely Coleptera, Lepidoptera, Gymnosomata, Diptera, Hemiptera, Hymenoptera and Orthoptera with the number of insects different at each altitude.

On coffee plantations at an altitude of 550 m above sea level, 212 non-target insects were trapped. In coffee plantations at an altitude of 850 m above sea level, 276 non-target insects were trapped. On coffee plantations at an altitude of 1,000 m above sea level, 95 non-target insects were trapped. On coffee plantations at an altitude of 1,150 m above sea level, 85 non-target insects were trapped, as shown in table 3.

Table 3. Other types of non-target insects trapped by attractants

Types of Insects Not Target	Order	Amount Trapped on Land Height (m above sea level)			
		550	850	1,000	1,150
Butterfly	Lepidoptera	12	15	0	1
Caterpillars	Lepidoptera	4	20	2	5
Snail	Gymnosomata	7	15	9	5
Mosquito	Diptera	20	35	10	0
Walang Sangit	Hemiptera	25	43	14	10
Black ant	Hymenoptera	20	48	10	13
Soldier Beetle	Coleoptera	27	5	14	5
Grasshopper	Orthoptera	35	53	17	20
Red Ant	Hymenoptera	19	48	6	10
Koksi beetle	Coleoptera	43	10	13	9
Total		212	276	95	85

The results of identification during 56 days of research showed that the non-target insects with the largest population were in coffee plantations at an altitude of 550 m above sea level and 850 m above sea level, which were dominated by insects of the order Hymenoptera, Orthoptera , Celeoptera and Hemiptera . This is related to the insect's living environment which is influenced by temperature, humidity and intensity of sunlight. According to Kamal et al. (2011), biotic and abiotic environmental components influence the abundance and diversity of biota in a place. The ideal temperature range for the development of insect populations is 15 0 C-45 0 C with an optimum temperature of 25 0 C. At the optimum temperature, insects are generally very abundant because they reproduce better (Shah et al., 2021).

In contrast to coffee plantations at altitudes of 1,000 and 1,150 m above sea level, the population of non-target insects that enter the traps tends to be lower. This is likely due to lower temperatures and higher air humidity not supporting insect breeding. According to Wiryadiputra (2007), around 2 - 6% of other insects can be trapped but not entirely because of the aroma of the attractant. It is thought that insects other than the coffee berry borer were caught by chance.

Hypothenemus hampei Ferr Attacks After Installing Attractant Traps

The results of analysis of variance of observational data and calculations of the intensity of attacks by coffee berry borers after installing attractant traps showed that the intensity of attacks on the four fields was significantly different. After 56 days of installing attractant traps, the intensity of attacks on land at an altitude of 550 m above sea level was 80.11%, at an altitude of 850 m above sea level the intensity of attacks was 56.74%, at an altitude of 1,000 m above sea level the intensity of attacks was 49.33 and the lowest attack intensity was found on land at an altitude of 1,150 m above sea level (only 28.45%).

Table 4. Test of differences in the average intensity of coffee berry borer attacks at different altitudes before and after control using attractants

Type Height (m above sea level)	Average Intensity of Coffee berry borer Attacks (%)				Subtraction
	Before Control	Category	After Control	Category	Intensity Attack (%)
550	94.75 a	Puso	80.11 b	Heavy	19.64
850	72.26 b	Heavy	56.74 a	Heavy	17.52
1,000	62.02 c	Heavy	49.33 c	Currently	12.69
1,150	39.48 d	Currently	28.45 d	Currently	11.03

Note: Numbers followed by different letter notations in the same column indicate that they are significantly different at the 5% level.

During the 56 days of attractant installation, the attack intensity was calculated 8 times. After the attractant was installed, each field showed a decrease in attack intensity. Before installing the attractant, the intensity of coffee berry borer attacks on land at an altitude of 550 m above sea level was 94.75%, decreasing to 80.11% (a decrease of 14.64%), the puso attack category decreased to heavy attacks. On land at an altitude of 850 m above sea level, before installing attractants, the intensity of coffee berry borer attacks was 72.26%, after installing attractants it decreased to 56.74% (a decrease of 17.52 %). However, the intensity of the attacks remains in the heavy category. On land at an altitude of 1,000 m above sea level before the attractant was installed, the intensity of the coffee berry borer attack was 62.02%, after the attractant was installed it decreased to 49.33% (12.69 % decrease) and the attack category changed from heavy to moderate. The intensity of coffee berry borer attacks on land at an altitude of 1,150 m above sea level before attractant installation was 39.48%, decreasing to 28.45% after attractant installation (11.03% decrease). However, the attack category before and after installing the attractant did not change (remained in the moderate category).

Differences in the height of coffee plantations result in significantly different intensity of coffee berry borer attacks. The lowest attack intensity (28.45%) was produced by the highest land (1,150 m above sea level), significantly different from the intensity on other land. The highest intensity of coffee berry borer attacks was found on land 500 m above sea level (80.11%). The reduction in attack intensity after installing attractants was apparently unable to prevent farmers' losses, because the attack category on the two types of land 550 and 850 m above sea level was in the heavy category and land heights 1,000 and 1,150 m above sea level were in the medium category, even though control efforts had been made.

The number of coffee berry borers trapped by attractants during the research reached 2,276 on land 550 m above sea level, 2,102 on land 850 m above sea level, 5,250 on land 1,000 m above sea level and only 1,392 on land 1,150 m above sea level. The reduced intensity of coffee berry borer attacks at the end of the study was also influenced by the number trapped. However, from these results, it is known that the type of attractant used is not effective in reducing the intensity of attacks, both on coffee plantations in the lowlands, medium plains and on coffee plantations in the highlands. The histogram of the intensity of coffee berry borer attacks after installing attractants on coffee fields at different heights can be seen in figure 2.

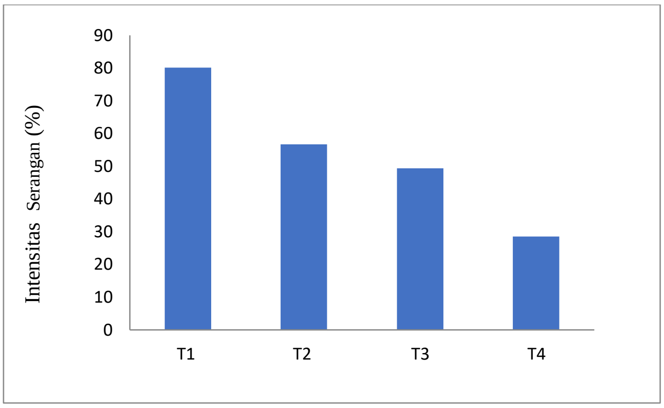

Figure 2. Histogram of the intensity of coffee berry borer attacks on coffee fields at different altitudes after installing attractants.

From the results of temperature and humidity measurements on land at an altitude of 550 m above sea level, 850 m above sea level and at an altitude of 1,000 m above sea level, no significant differences were found. The optimum temperature for the development of coffee berry borers is 25°C-26°C and optimum humidity 90%-95%. These conditions of elevation, temperature and humidity mean that the abundance of trapped coffee berry borer insects is also high. Siregar (2016) stated that coffee berry borer pest attacks will be higher at elevations of 500 - 1,000 m above sea level. The elevation of the planting site will be highly correlated with temperature and humidity, where the average temperature in the observation area for 56 DSA is 22.07 ^{0}C and the average humidity is 83%.

The difference in attack intensity is caused by several physical factors. At an altitude of 1,150 m above sea level, the development of *Hypotenemus hampei* Ferr. become more obstructed. In highland areas >1,000 m above sea level the development of coffee berry borers will be hampered. The results of the author's research are in line with the survey conducted by (Samosir et al., 2013). Consecutively from lower to higher altitudes, the intensity of coffee berry borer attacks in Pane District (± 550 m asl) was 88.83%, in Raya District (± 900 m asl) was 83.50%, and in Purba District (± 1,300 m above sea level) it was 26.83%. This indicates that the higher the planting area above sea level, the smaller the intensity of coffee berry borer attacks.

During the 56 day observation period, it was discovered that the average temperature on land at an altitude of 1,150 m above sea level was 19.50°C and the average humidity was 90%. These temperature and humidity conditions are thought to be suitable to inhibit the development of *Hypotenemus hampei* Ferr. Jaramillo et al. (2009) said that air temperature affects the level of *Hypotenemus hampei* Ferr attacks. The optimal temperature for development is 25°C-26°C with a minimum temperature limit of 15°C and a maximum of 35°C.

It is known that during 56 days of research, on land at an altitude of 1,150 m above sea level, *Hypotenemus imago hampei* Ferr. There were 1,392 trapped individuals. With the ability to trap 1,392 individuals for 56 days, the control of coffee berry borer pests is quite good in reducing the intensity of attacks, especially since it is known that at the height of this land before attractants were installed, the intensity of coffee berry borers was relatively light

Conclusion

The height of the location of the coffee plantation influences the intensity of attacks by the coffee berry borer *Hypotenemus hampei* Ferr. The higher the coffee plantation, the intensity of attacks tends to decrease and vice versa. Of the 4 types of altitudes where coffee plantations were studied, the lowest attack intensity (28.45%) was obtained in coffee plantations at an altitude of 1,150 m above sea level. The attractant types *Hypotan, Koptan* and *Atrakop showed no significant difference in effectiveness in trapping the coffee berry borer Hypothenemus hampei* Ferr insect pest. However, these 3 types of attractants have not been able to reduce the intensity of attacks from puso, heavy and moderate categories to light attack categories.

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Place acknowledgments, including information on grants received, before the references, in a separate section, and not as a footnote on the title page

Author Contributions
In this short study, researchers state that all contributors play an active role in the portion of cooperation that has been agreed together, so that the contribution is very valuable and provides an extraordinary completeness of the study.

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Conflicts of Interest
The authors declare no conflict of interest.

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