The influence of attractant from coffee bean and outer skin of coffee to imago of coffee berry borer *Hypothenemus hampei* Ferr. (Coleoptera: Curculionidae) on the field

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Abstract. One of Environmentally friendly control of *H. hampei* is using the coffee attractant based on the content of organic volatile compounds (kairomone). The objective of this study was to determine the effect of coffeebean extracts and fruit peels as attractants on the traps of trapped female *H. hampei*. The study was conducted at the Small holders Coffee Plantation in Sukanalu Village, Barus Jahe District, Karo Regency, North Sumatra Province, Indonesia from May July 2018. The experiment was designed as Split Plot Design which consists of 2 factors. The first factor was the types of attractant (the attractant of coffee bean extract and the extraction of coffee pods), while the second Factor was the concentration of attractants (without attractants, 10%, 30% and 50%). The results showed that the best attractant was coffee bean extract with a concentration of 30% (99.59 adult). While 50% coffee fruit skin attractant can control *H. hampei* (60.91 adult). The results also showed that type and concentration attractant, as well the interaction of both influences were very significant on the number of females of *H. hampei* trapped.

1. Introduction
One effective and environmentally friendly control solution in suppressing *Hypothenemus hampei* population is using attractant compounds of several parts of coffee plants. The attraction of *H. hampei* on extracts of coffee plantations may due to the content of chlorogenic acid which is able to attract immunity in laying eggs [1]. The content of chlorogenic acid is found in all parts of the coffee plant, thus it has the potential to be developed as a natural attractant compound.

Coffee fruit contains about 5 types of organic volatile compounds that are able to attract insect pests. The dominant organic volatile chemical compounds found includes *piroacetal conophthorin, frontalin* and *methyl 3-ethyl-4-methyl pentanoate* [2]. The content of organic volatile compounds (kairomone) in coffee bean can attract the female of *H. hampei* in colonizing coffee berries [3]. In general, the content of volatile organic compounds in the ripe fruit more 10 times more than the fruit is still young [2].

The use of attractant made from bean extracts of coffee plants had better results in attracting the image of *H. hampei* females compared to the use of a mixture of ethanol and methanol compounds [3]. The attraction in imago of *H. hampei* females and branch borer (*Xylosandrus compactus*) to ripe
coffee berries extracts are greater than immature coffee berries extracts or dried coffee fruit on trees [4].

The coffee plant extract can also be used as an attractant in controlling cocoa plant pests. Coffee bean extract with a concentration of 5% and 7% was able to attract the imago of Conopomorpha cramerella compared to extracts of cocoa peel. The utilization of coffee leaf extract with a concentration of 5% as an attractant compound was also able to attract the image of C. cramerella [1]. Arabica’s coffee berries also produces chemical compounds whose components resemble the pheromone sex compound of the Scolytidae type of insect [2]. The content of chlorogenic acid compounds in coffee extracts (exokarp) was able to attract H. hampei [1,2].

The potency of distilled water from the coffee plant parts (coffee, coffee beans, coffee leaves and coffee branches) could be used as attractant against female imago of H. hampei in laboratory. The study showed that the average of female imago of H. hampei at a concentration of 4% was 4.0, 8.8, 2.2 and 2.2 imago respectively [5].

The application of extracts from coffee beans and coffee peels as attractants have not been used in Indonesia and their effect on the H. hampei imago has not been explored intensively, particularly in the field work.

The objective of this study was to determine the effect of coffeebean extracts and fruit peels as attractants on the traps of trapped female H. hampei.

2. Materials and Methods

2.1 Location
The study was conducted at the Small holder's Coffee Plantation in Sukanalu Village, Barus Jahe District, Karo Regency, North Sumatra Province, Indonesia from May until July 2018.

2.2 Research methodology
The study used a separate plot design with 2 factors. The first factor was type of attractant (A) with 2 levels of treatment, namely; Coffee bean extract (A_1), and coffee fruit peel extract (A_2). The second factor was the concentration of attractant (K) with 4 levels of treatments, namely; without attractant (K_0), Attractant concentration of 10% (K_1), Attractant concentration of 30% (K_2), Attractant concentration of 50% (K_3). The study was conducted with four replications, therefore there were 32 different combinations of treatments. Data were analyzed by Analysis of Variance (ANOVA) and further tested in treatments that significantly affected Duncan's Multiple Distance Test (DMRT) at the level of 5%.

2.3 Preparation of trap
Traps were used from used 1.5 liter mineral water bottles. Two rectangular holes (size of 4x4 cm) was made on the opposite side, straight direction toward the treatments. Plastic bottle size of 10 ml was used for attractant. A total of seven holes (0.5 mm) were drilled for the discharge of attractants and attached to the perforated mineral water bottle cap (Figure 1.). The bottom of the trap was 250 ml of salt water solution to catch interested insects.
2.4 Preparation of attractants
Outer skin of coffee beans and beans of freshly coffee, which were harvested, were peeled and dried for approximately 3 days, then smoothed by using a blender. The smooth skin and coffee beans were weighed 500 grams each and then put into 1000 ml in Erlenmeyer separated for extraction. Technical ethanol solvent of 1000 ml was added into the media until submerged and was left for 24 hours, after which the extract was filtered using filter paper and funnel glass. This media extraction was carried out in three replications. The extract was evaporated by the solvent using a rotary evaporator to obtain a thick extract. Then the extract was transferred to the packaging bottle in the field.

2.5 Trap installation
Traps containing attractant and salt water solution were installed. Reviewed on coffee planting area on a height of 1, 5 meters in coffee branches that have fruit with distance each 10 meter trap (Figure 2).
2.6 Collecting of trapped imago
Observation was done once week for 8 times of observation by pouring salt water solution into transparent plastic by using funnel then was tied with rubber band and was labeled according with each treatment. Salt water solution was replaced again with the new one. Samples were brought to Laboratory of Pest, Balai Besar Perbenihan and Proteksi Tanaman Perkebunan (BBPPTP) Medan for calculating the number of trapped *H. hampei* imago.

3. Results and Discussion
The results showed that extract of coffee beans and coffee skin were potential as attractants to attract adult female *H. hampei*. The study resulted that adult female *H. Hampei* trapped after 8 weeks application presented on Table 1.

Table 1 shows that type of attractants, the concentration of attractants and combination of both were very significantly effect on the number of adult females of *H. hampei* that caught. The highest mean of adult females *H. hampei* was on coffee bean extract with concentration of 30% (A1 K2) (99.59 adult) which was significantly different from other treatments. While the lowest number of adult female *H. hampei* trapped was in treatment A2 K0 (0.34 adult) were not significantly different with treatment A1 K0 (0.84 adult). Attractant of coffee bean was better in attracting adult female *H. hampei* compared to attractant from outer skin of coffee beans because coffee bean extract containing volatile compounds is higher than the outerskin coffee extract, which is ten of times higher than other parts of the coffee plant. The use of attractants made from the base of ripe coffee bean extract has better results in attracting the female *H. hampei* compared with the use of a mixture of ethanol and methanol compounds [3].

| Treatments | Time (week) | Mean |
|------------|-------------|------|
|            | 1           | 2    | 3    | 4    | 5    | 6    | 7    | 8    |
| A1 K0      | 1.75        | 0.50 | 0.25 | 1.00 | 1.75 | 1.00 | 0.25 | 0.25 | 0.84 e |
| A1 K1      | 130.75      | 34.00| 9.00 | 89.50| 145.25| 34.00| 42.25| 5.25 | 61.25 b |
| A1 K2      | 219.75      | 48.25| 14.75| 139.25| 219.75| 72.00| 73.25| 9.75 | 99.59 a |
| A1 K3      | 118.75      | 23.25| 8.50 | 62.75| 127.75| 39.50| 52.25| 9.75 | 55.31 c |
| A2 K0      | 0.75        | 0.25 | 0.00 | 1.00 | 0.00 | 0.25 | 0.50 | 0.00 | 0.34 e |
| A2 K1      | 146.25      | 32.00| 12.00| 61.50| 110.75| 40.25| 43.50| 6.25 | 56.56 c |
| A2 K2      | 63.75       | 17.00| 4.50 | 53.75| 101.50| 27.00| 27.50| 4.75 | 37.47 d |
| A2 K3      | 189.50      | 46.50| 6.25 | 69.00| 122.50| 29.25| 22.50| 1.75 | 60.91 b |

Note: Numbers followed by the same notation on the same line indicate a non-significant difference according to Duncan's Multiple Range Test at the 5% level.

The volatile compounds in coffee extracts (exocarp) turned out to be able to attract female imago of *H. hampei* but the results are lower compared to coffee bean extracts according to the results of [5] in the laboratory, showed that the potential for distilled water from coffee plants (fruit peel, seeds, leaves and twigs of coffee) was able to attract the imago of *H. hampei* females. The average yield was 4.0 adult, 8.8 adult, 2.2 adult and 2.2 adult at a concentration of 4%.

The development of adult female *H. hampei* which were trapped by the concentration of coffee bean extract attractant for 8 weeks presented on Figure 3.

The progress of adult female *H. hampei* trapped by the attractant effect of the coffee peel extract for 8 weeks presented on Figure 4.
Figure 3. The number of females of *H. hampei* trapped in the treatment of attractant concentration treatment coffee bean extract for 8 weeks of observation.

The number of trapped imago of *H. hampei* fluctuated (Figures 3, 4). From Figure 3 and Figure 4 show that in the first week the number of imago of *H. hampei* which is observed trapped in coffee bean extract treatment and the extraction of coffee peels are increase, at the second week and third week have decrease. In the fourth and fifth weeks, there was a return, the sixth week have decline again while in the seventh week it increased again and in the eighth week it is decline. It can be seen that there is a significantly of dynamics in the number of adult female *H. hampei*. The highest number of imago *H. hampei* trapped is found in the first and fifth week observations.

Figure 4. The number of adult female *H. hampei* trapped in the treatment of attractant concentration treatment coffee peel extract for 8 weeks of observation.

In the use of attractants in the field, the number of *H. hampei* that are trapped are influenced by climate such as wind direction, weather and temperature, because attractants are compounds that emit aromas or odor capable stimulate *H. hampei* for interested or approaching because like the aroma in accordance with [2] interest insect this depends on condition growth coffee plants (climate, arrangement distance planting, to humidity, cultivars, age of plant, wind direction, wind velocity, etc.) can influence arrest pest this. Increased number of adult female population of *H. hampei* trapped is also have close relation to the life cycle of *H. hampei* because the lower the temperature of the life
cycle will be longer. Increasing of the number of females of *H. hampei* trapped again in the third week of observation and decreased during the sixth week (21 days), with the temperature at the study site between 23°C-26°C this proves the life cycle of *H. hampei* was affected by temperature. This is also consistent with [6] who stated that at a temperature of 27°C the life cycle of *H. hampei* imago was 21 days, the temperature of 22°C was 32 days and the temperature of 19.2°C was 63 days.

The trapping of *H. hampei* imago was highest in the first and fifth weeks, which was the peak activity of flying from imago *H. hampei*, this possibility comes from the second or third generation of *H. hampei* to attack new coffee berries. Whereas, in the second, third and fourth weeks, the generation of *H. hampei* is still in the coffee berries in the endosperm. Increased infestation at harvest is likely to come from the second or third generation of *H. hampei* which attacks new fruit. Although the amount of fruit and infestation rate is low during this time [7].

### 4. Conclusion

The results of the study revealed that the best attractants that could be used as *H. hampei* traps were coffee bean extracts with a concentration of 30%. However, generally coffee beans tend to be used by the community for consumption so that the use of coffee peel skin attractants becomes another alternative to control *H. hampei* with a concentration of 50%.

### References

[1] Firmansyah A P, Sjam S and Dewi V S 2012 Coffee Beans Extract as an Attractor Imago Cocoa Fruit Borer (*Conopomorpha cramerella* Snellen) (Ujung Pandang: Hasanuddin University)

[2] Jaramillo J, Torto B, Mwenda D, Troeger A, Borgemeister C, Poehling H M, Francke W 2013 Temporary coffee berries joins bar beets in klatch coffee *J.Plos ONE* 8 9 pp 1-15

[3] Dufour B P and Frérot B 2008 Optimization of temporary coffee berry, *Hypothenemus hampei* Ferrari (Coleoptera: Scolytidae), mass trapping with an attractant mixture *J. Appl.Entomol.* 132 pp 591-600

[4] Giordanengo P, Brun L O and Frerot B 1993 Evidence for allelchemical attraction of the coffee berry borer, *Hypothenemus hampei*, by Coffee Berries *J. Chemic. Ecolog.* 19 pp 763-9

[5] Rasiska S, Ariyono D and Widiantini F 2016 Potential of distilled water in several parts of coffee plants as an attractor to Coffee Fruit Borer (*Hypothenemus hampei* Ferr.) in the laboratory *J. Agri.* 27 2 pp 112-9

[6] Barrera J F 2008 Coffee pests and their management. In: *Encyclop. Entomol. second ed.* Springer p 961-98

[7] Aristizabal L E, Johnson M, Shiner S, Hollingsworth R, Nicholas C, Manoukis, R. Myers and Arthurs S 2017 Integrated pest management of Coffee Berry Borer in Hawaii and Puerto Rico: current status and pospects *Insect* 8 pp 1-16