Comparison of Attractants and Height Traps to Coffee Berry Borer (Hypothenemus hampei Ferr., Coleoptera: Scolytidae) in Soban Village, Dairi Regency, North Sumatra, Indonesia

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Abstract. This study aims to compare the effectiveness of two attractants and three different heights trap to trap coffee berry borer Hypothenemus hampei Ferr. (Coleoptera: Scolytidae). This research was conducted at a coffee plantation in Soban Village, Dairi Regency, North Sumatra, using a Factorial Randomized Block Design (RBD) with two factors. The first factor was the type of attractants (control, coffee bean, and coffee bean pod (exocarp)), and the second factor was the height of the traps (1, 1.5, and 2 meters). The results showed that the attractant from coffee beans with a trap height of 1.5 meters gave the best results with the number of adult coffee bean borer trap catches was 1,377.00 adults, and significantly reduced the percentage of attack by 26.95% compared to other treatments.

1. Introduction
Robusta is a coffee variety that dominates in Indonesia. Coffee entrepreneurs are expected to contribute to the improvement and welfare of farmers. But in reality, coffee production is still far from the expected productivity [1]. One of the causes of the decline in coffee production is the attack of coffee berry borer (CBB) [2]. The level of damage caused by CBB reaches up to 50% [3]. This pest causes direct damage to the seeds. Berry that is attacked, usually, there is dirt in the apical scar [4]. This pest can reduce the yield and quality of coffee. Damage caused by CBB causes the rot seeds [5]. This pest spends most of its life in berry coffee that is difficult to control [6].

General control using by farmers is the use of synthetic insecticides because it has the effect of reducing the population of pests quickly. Synthetic insecticides can have negative impacts such as environmental pollution and resistance to some insect pests [7]. Furthermore, the use of this insecticide can increase pesticide residues in berries [8].

One of the environmentally-friendly control techniques in suppressing CBB populations is to use attractants. Attractant is a substance (like pheromone) that attract specific insects or pests. Reported that attractants made from coffee beans had better results in attracting adult female CBBs than ethanol and methanol because coffee plants contain chlorogenic acid which has the potential to control CBB [9].

Balai Besar Perbenihan and Proteksi Tanaman Perkebunan, Medan has found atractants from coffee beans and skin that can be used to control CBB, but have not been tested in the field so they cannot be traded. Therefore, the authors are interested in testing attractants from coffee bean skins and skin to control CBB.
2. Materials and methods

2.1 Method
The method used in this study was a factorial Randomized Block Design (RBD) with two factors and three replications. The first factor was the type of attractant (control, beans, and coffee beans) (exocarp), and the second factor was the height of the trap (1, 1.5, and 2 m).

Observation variables were the number of adult coffee bean borer caught, and the percentage of attacks. Percentage of attacks assessed by the formula: Percentage of infected fruit (I) = number of coffee attacked (a) / total number of coffee fruit (b) x 100%.

2.2 Statistical analysis
Data analyzes were performed according to standard statistical analysis by ANOVA using Microsoft Excel. Comparison between the average performed by Duncan test 5%.

3. Results and discussions
The results showed that the interaction between attractant types and trap height significantly affected the number of adult coffee bean borer caught. The best results were obtained in the treatment of the attractant from coffee beans with a trap height of 1.5 meters with the number of adult coffee bean borer catches was 1,377.00 adults (Table 1), and significantly reduced the percentage of attacks by 26.95% compared to other treatments (Table 2).

Table 1. The average number of imago CBB trapped with the type of attractants and trap heights (m)

| Observations | A0T 1 | A0T 2 | A0T 3 | A1T1 | A1T2 | A1T3 | A2T1 | A2T2 | A2T3 |
|-------------|------|------|------|------|------|------|------|------|------|
| 1           | 0:00 | 0:00 | 0:00 | 53.00 | 55.00 | 79.33 | 30.33 | 21.33 | 42.67 |
| 2           | 0:00 | 0:00 | 0:33 | 79.33 | 270.33 | 175.00 | 309.33 | 332.33 | 124.33 |
| 3           | 0:00 | 0:00 | 0:00 | 304.33 | 997.33 | 405.00 | 678.00 | 789.67 | 332.33 |
| 4           | 0:00 | 0:00 | 0:33 | 428.67 | 1377.00 | 375.67 | 337.67 | 1121.00 | 362.33 |
| 5           | b     | b     | b     | a     | b     | a     | b     | a     | b     |
| 6           | 0:00 | 0:00 | 0:33 | 302.00 | 771.33 | 354.67 | 331.67 | 829.33 | 363.67 |
| 7           | 0:00 | 0:00 | 0:33 | 123.33 | 352.00 | 138.67 | 295.33 | 494.67 | 164.00 |
| 8           | 0:00 | 0:00 | 0:00 | 146.00 | 345.00 | 251.00 | 146.33 | 257.67 | 180.00 |
| 9           | 0:33 | 0:67 | 0:67 | 405.00 | 853.33 | 398.33 | 145.00 | 533.67 | 356.33 |
| 10          | 0:00 | 0:33 | 0:33 | 144.33 | 284.33 | 142.00 | 94.00  | 315.67 | 205.33 |
| 11          | 0:33 | 0:67 | 0:00 | 59.33  | 143.33 | 81.00  | 68.00  | 114.67 | 89.67  |
| 12          | 0:00 | 0:00 | 0:00 | 121.67 | 271.67 | 72.67  | 168.00 | 108.00 | 73.00  |
| 13          | 0:00 | 0:00 | 0:00 | 67.33  | 73.00  | 70.33  | 48.67  | 72.00  | 53.00  |
| 14          | 0:00 | 0:33 | 0:00 | 158.00 | 96.67  | 192.33 | 120.33 | 82.00  | 115.00 |
| 15          | 0:00 | 0:00 | 0:00 | 36.67  | 49.33  | 38.00  | 36.33  | 16.67  | 22.33  |
| 16          | 0:00 | 0:00 | 0:00 | 7.67   | 7.67   | 3.00   | 4.00   | 2.33   | 5.67   |

Notes: The numbers followed by the same letter notations in the same table are not significantly different on Duncan’s multiple range test with level of 5 %
A0T1 : Control and 1 m
A0T2: Control and 1.5 m
A0T3: Control and 2 m
A1T1: Coffee bean and 1 m
A1T2: Coffee bean and 1.5 m
A1T3: Coffee bean and 2 m
A2T1: Exocarp and 1 m
A2T2: Exocarp and 1.5 m
A2T3: Exocarp and 2 m

Attractant from coffee beans is better at attracting CBB compared to attractants from coffee beans pod (exocarp), and control. This is because the hexadecanoic acid content in coffee beans is higher (32.39%) than hexadecanoic acid in coffee beans pod (7.48%) [10]. [11] Reported that hexadecane was an attractive compound for CBB pests. Traps with a height of 1.5 meters obtained the highest number of trapped CBB compared to other trap heights. This was because at that height there were still coffee fruit [12], and CBB can still be caught at an altitude of 1.75 meters above ground level [13]. Hexadecanoic acid is a volatile compound. This combination of volatile compounds provides a real response to adult female CBB interest [14].

### Table 2. The average percentage of attacks on CBB with the type of attractants and trap heights (m)

| Observation | A0T1 | A0T2 | A0T3 | A1T1 | A1T2 | A1T3 | A2T1 | A2T2 | A2T3 |
|-------------|------|------|------|------|------|------|------|------|------|
| 1           | 58.17 | 41.44 | 60.71 | 42.28 | 36.50 | 39.90 | 55.43 | 53.76 | 49.22 |
| 2           | 41.44 | 38.90 | 51.82 | 36.50 | 36.50 | 47.49 | 56.68 | 52.94 | 27.98 |
| 3           | 60.71 | 63.26 | 57.10 | 39.90 | 50.26 | 43.91 | 45.51 | 53.31 | 45.60 |
| 4           | 37.81 | 53.73 | 38.18 | 49.44 | 45.30 | 49.33 | 62.11 | 52.57 | 61.36 |
| 5           | 24.38 | 55.86 | 33.25 | 62.23 | 31.75 | 52.94 | 61.54 | 59.65 | 34.83 |
| 6           | 44.90 | 66.19 | 51.64 | 50.70 | 37.85 | 50.96 | 39.42 | 57.35 | 35.63 |
| 7           | 51.31 | 53.69 | 51.52 | 49.83 | 42.71 | 49.23 | 52.24 | 52.75 | 50.16 |
| 8           | 60.37 | 52.45 | 55.97 | 35.40 | 44.11 | 48.92 | 64.67 | 56.33 | 39.26 |
| 9           | 55.41 | 64.83 | 41.57 | 43.71 | 37.09 | 37.41 | 49.87 | 52.16 | 54.34 |
| 10          | 56.61 | 53.22 | 45.42 | 48.62 | 49.34 | 21.63 | 56.35 | 30.46 | 42.31 |
| 11          | 39.90 | 59.38 | 37.91 | 44.95 | 40.66 | 43.69 | 35.54 | 53.04 | 32.88 |
| 12          | 41.20 | 37.76 | 46.64 | 42.32 | 40.28 | 40.75 | 42.14 | 56.59 | 36.74 |
| 13          | 38.26 | 54.40 | 42.59 | 44.04 | 38.27 | 35.89 | 39.19 | 42.68 | 38.54 |
| 14          | 36.11 | 45.30 | 42.22 | 50.04 | 32.96 | 33.08 | 44.57 | 40.62 | 36.74 |
| 15          | 35.88 | 50.60 | 33.56 | 32.09 | 39.06 | 40.76 | 30.75 | 46.13 | 39.06 |
| 16          | 34.82 | 33.16 | 46.98 | 25.68 | 35.94 | 38.09 | 42.10 | 41.79 | 27.03 |

Notes: The numbers followed by the same letter notations in the same table are not significantly different on Duncan’s multiple range test with level of 5%
A0T1: Control and 1 m
A0T2: Control and 1.5 m
A0T3: Control and 2 m
A1T1: Coffee bean and 1 m
A1T2: Coffee bean and 1.5 m
A1T3: Coffee bean and 2 m

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4. Conclusions

The attractant from coffee beans with a trap height of 1.5 meters gave the best results with the number of adult coffee bean borer trap catches was 1,377.00 adults. The attractant from coffee beans with a trap height of 1.5 meters were reduced the percentage of attack by 26.95%.

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