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Full Length Research Paper

Attractant Coffee to Detect of Distribution of *H.Hampeii* in Sumbul Village, Dairi District, Sumatera

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Dairi district is one of regency in Northern Sumatra produce of coffee plantations. The research was done during July until August 2016 in Sumbul Village, Dairi district with two varietes of coffee, such as Robusta and Arabica with each locations taken at 5 treatment in 5 sites which total as 50 coffee plantations were determined in the fields. The treatments consists of 5 levels, such as; K0: Control (without aquadest destilate); K1: chlorogenic acid extract I (added aquadest destilate 25 ml); K2: chlorogenic acid extract II (added aquadest destilate 50 ml); K3: chlorogenic acid extracts III (added aquadest destilate 75 ml); K4: chlorogenic acid extracts IV (added aquadest destilate 100 ml). The insects recorded consist of 10 orders, 30 families with 30 genera are collected on coffee plantation in Sumbul village.The highest individual found in Sumbul from Families Scolytidae (*H.hampei*, 36 individuals), followed by Family Formicidae (*Formica* sp, 19 individuals) and the Family Vespidae (*Dolochovespula* sp, 12 individuals), compared with total individuals recorded in Sidikalang consists of Scolytidae (41 individuals), Vespidae (14 individuals) and Formicidae (12 individuals). The score diversity (H') varies with the very good diversities category, namely H'=2.26 (in Sidikalang district) and H'=1.98 (in Sumbul village). The most effective for controlling pests of CFB in the field of five traps such as *Yellow Trap*/YT (P <0.019 **); followed by *Attractant Trap*/AT; *Red Trap*/RT; *Sweep Net* /SN; and *Pit Fall Trap*/PT.

Keywords: Attractant, coffee, H.hampeii, Sumbul, North of Sumatra.

INTRODUCTION

Coffee is one important agricultural commodities in Indonesia. In Northern Sumatera, coffee is the source of beverage consumed by the community of Dairi district district. Two types, such as Robusta and arabica coffee are known in Indonesia. Arabica coffee is the only type of commercial coffee grown in Indonesia, but the leaf rust disease (*Hemileia vastatrix*) enter to Indonesia since 1876. Meanwhile, Arabica coffee can thrives at an altitude of 1000 masl (metre above sea level), where the disease can not great live. Arabica coffee plantation is still found in the highlands Ije area (East of Java), Tanah Toraja (South of Sulawesi), the Central, Highlands in Nanggroe Aceh Darussalam, and the upper slope of Bukit Barisan (Sumatera), such as: Mandhailing, Lintong and Sidikalang in North of Sumatra. North Sumatra Province is one of the coffee-producing areas in Indonesia. The most famous districts produce of coffee in Northern Sumatra, such as Mandhailing, Simalungun, Karo and Dairi district. Dairi

district produce two types of coffee are Arabica and Robusta. Robusta coffee has two higher caffeine than arabica coffee, which is about 70-80 percent (Khairati, 2012). North of Sumatra coffee productivity is lower compared to the coffee production in other countries. North Sumatra from Arabica coffee productivity is only 1,154 kg/ha/year, while Costa Rica 1,610 kg/ha/year. Robusta productivity of 649 kg/ha/year compared recorded in Laos 738 kg/ha/year. There are four factors that determine the success of coffee cultivation, namely: (1) techniques provision of production facilities, (2) production/cultivation process, (3) post-handling techniques harvesting and processing (agroindustry), and (4) its marketing system. Fourth is a continuous activity that should be applied properly and (Center for Assessment and Development of Agricultural Technology, 2008). In addition, the most important factor in reducing coffee productivity is pests and diseases. Several types of pests that attack coffee plantation, namely *Hypothenemus hampei* (coffee coffee borer), *Zeuzera* sp (stem borers), *Xylosandrus* spp (branch borers), *Cocus viridis* (a green tick), and *Ferrisia virgata* (mealybugs) (Siregar, 2016a,b).

Otherwise, a lack of understanding of coffee farmers on the cultivation of coffee, such as low input of fertilizers, lack of maintenance of plants, lack of shade plants, his age of the plant, and the high pest in Borer Coffee Fruit (CFB) effected to coffee plantation (Malau et al., 2012; Siregar, 2016c). Coffee fruit borer (CFB) or *Hypothetamus hampei* is a major coffee pest that poses a serious problem in Indonesia, since it has attacked almost all coffee plantations and is very detrimental to farmers. Loss of results due to CFB attacks can reach is 64.90 to 82.20% (Wardojo, 1980). CFB stagnant during the larval phase. Newly hatched larvae inside of the young fruit, then it eats fruit flesh and food ducts, so affected to the seed. After the ripe fruit then appears symptoms of an attack of CFB. This is seen from the color of the fruit skin to faded and arise colored orange. When the fruit is shaken does not cause a sound, when split black fruit flesh color, the seeds are attached to each other, black, wrinkled and lightweight, and low quality. This insect phenomenon provides constraints in its control efforts, especially for controlling the larval phase contained in the fruit so that one of the control alternatives is directed to adult insects or imago phase.

The control of CFB pests by using synthetic insecticides that can only be applied to the leaves and fruit so this way is considered less successful. One of the ways imago of CFB control at the moment is with the use of synthetic sex pheromone traps that have been developed by some companies. Examples of sex pheromones in the form of "CPB-Lure" are extracted from the female imago to attract the male imago. Traps mounted as high as 0.5 m above the canopy of the coffee plant. Not long after trapping, the male imago CFB will be interested to come so caught and dead (Wahyudi, 2011; Wirdiputra, 2014). Since this pheromone only attracts male insects, it is unlikely to have a significant effect on the intensity of CFB attacks, so although it is proven to capture large quantities of CFB pests but its effectiveness to decrease the attack rate and damage of pests of CFB in the field needs to be further studied (Nugroho, 2015; Siregar, 2016).

From various research results indicate that extract the material of natural plants can also be used as pullers in trapping CFB. Several studies of coffee fruit extracts of both the ecocarp and mesocarp coatings may attract CFB insects and the mixture of fruit coffee peel extracts both the eksokarp and mesocarp coatings led to increased interest in CFB (Isyana and Ivanova, 2011). The interest of CFB in coffee peel extract is caused by a chemical compound. According to Harborne *et al*. (1987), Tice (1998), and Firmansyah (2013) on fruit and coffee beans there are compounds chlorogenic acid (*chlorogenic acid*) which is a secondary metabolite compounds that can stimulating insects to lay eggs. Chlorogenic acid was first obtained in crystalline form by cortic and quinic condensation by Harborne (1987) derived from young coffee beans. These compounds in addition to antibacterial, antitumor, and antioxidants are also as an insect stimulant to lay eggs (AAK, 2008; James, 2007).

Coffee has the highest chlorogenic acid content in between plant species, 6-7% in Arabica and up to 10% in Robusta. The content of chlorogenic acid in coffee is thought to attract mature insects CFB. Evidence of this has been done, including research Robinson (1995), which gets the result that interest in adult insects CFB contained in the treatment of coffee leaf extract with a concentration of 5% higher in attracting CFB than 2.5% and 7.5% concentrations.

In terms of utilization of coffee fruit 3-4 months old for the extraction process is considered less effective because farmers need fruit enlargement to be taken as seeds of production. It takes an analogue or substitute in producing an extract that is able to attract and trap the imago of CFB in addition to the skin of a coffee fruit. Coffee beans contain the same chemical compounds as coffee peels. Therefore it is necessary to test the extract of coffee beans with various levels of concentration to determine the ability to attract imago of CFB compared with fruit coffee peel extract (Siregar, 2016a).

Dairi district district is one of the coffee-producing areas in Indonesia. Control with chemical insecticides are not effective because almost all developmental stages of the pest insects are inside the coffee fruit, so the quality of the coffee will be reduced if the applied chemical pesticides. Besides, farmers have problems in spraying because in general the height of the coffee tree taller than humans (Laila, 2012). Because the reason, it is necessary to measure insects diversities, the implications of the use of variese tools to trap and control the fruit borer coffee, *H.*

hampei populations as dominant pests discussed in the Sumbul coffee plantations.

METHODOLOGY

This research was conducted in Sumbul village of coffee plantations, Dairi district with a distance of 120 km from the city of Medan at altitudes above 1200 meters above sea level (asl). Survey method which purpossive random sampling were done from each of 2 locations in Sumbul with 2 varietes (Robusta and Arabica) with 5 samples treatment from each locations and continue identified of sampled into Laboratory of Pests and Diseases, Faculty of Agriculture, University of Sumatera Utara from July to August 2016. Robusta coffee fruit from Dairi district Regency pounded and separated between fruit peel and Seeds. Seeds then weighed as much as 500 g then pounded again using a mortal, and then placed into a glass jar. Seeds then soaked with technical methanol as much as 1 lt for 3 days. After 3 days, the extract is then filtered and transferred to another container. Soaking like this done 3 times, so that will be obtained 3 lt of fruit coffee extract ready to be processed. BAL 209 fruit fruit that is 3-4 months old peeled with a knife then mesokarp and endokarp taken and then put together. The fruit skin is then dried for 2 days. After that the skin of coffee fruit weighed as much as 1 kg then the fruit skin is finely chopped and put into a jar.

The next step, the skin of fruit then soaked with technical methanol as much as 3 lt. Immersion done for 3 days. Soaking like this done as much as 3 times, so that will be obtained 9 lt of fruit coffee extract ready to be processed. Extracts of coffee beans and fruit coffee peels are then evaporated using a rotavapor device, the purpose being to separate the extract from the methanol solvent. Rotavapor will evaporate methanol to form a fairly viscous extract. Extracts are fed into the refrigerator to be used in subsequent tests. All plant material extraction activities were carried out at into Laboratory of Pests and Diseases, Faculty of Agriculture, University of Sumatera Utara.

The pupa taken from the peel of coffee fruit that closed for 5 days by using coffee leaves. After 5 days the leaves as well as the skin of the coffee fruit are examined carefully. Pupa usually formed on the surface of the top or bottom of the leaves or on the sidelines of the groove of coffee fruit. The pupa obtained stored in container. Maintenance of pupa done at into Laboratory of Pests and Diseases, Faculty of Agriculture, University of Sumatera Utara. Then, the Pupa is stored in a plastic container topped with gauze, on the bottom of a plastic container smeared with anti-insect to prevent ants from coming. Maintenance is done until the pupa turns into imago, and is ready for use in the testing process.

The study randomized complete block design (RCBD) non factorial with 5 the best treatment of the observations in the laboratory with five groups so that there are 25 experimental units: K0: Control (Aquadest); K1: chlorogenic acid Extract I (plus water 25 ml); K2: chlorogenic acid Extract II (water plus 50 ml); K3: Extracts of chlorogenic acid III (water plus 75 ml); K4: Extracts of chlorogenic acid IV (plus water 100 ml). Each experimental unit consisted of two coffee planting locations with each location taken at random 5 by 5 treatment plants so that the plants experiment as much 2x5x5 = 50 coffee plantations. Data were analyzed using analysis of variance model of linear randomized block design using SPSS version 24.00.

Each extract will be installed using a triangle trap with 5 traps,such as sweep net,fit pall trap, yellow trap, red trap and Attractants trap. Traps will be installed 0.5 m above the coffee plant canopy. Traps fitted with 10 cm long wire and then attached to twigs or tree branching. Traps are installed on every 3 trees with a given distance between treatments ie 100 m. The parameters observed in this study were the number of adult CFB insects that were interested in the treatment being tested. Levels of interest of mature to CFB insect extracts were calculated on the basis of equations according to Sighomang *et al* (1984).

$$\text{Percentage of Interest} = \frac{(N-A)}{N} \times 100\%$$

Noted: N: The number of adult insects found in the treatment

A: Number of adult insects in control

Then, Classification of Interest: Class 0: Negative attractants; Class 1: 0 - 20% (Less or less); Class 2: 21,1% - 40% (Medium); Class 3: 40,1% - 60% (Enough); Grade 4: 61,1% - 80% (Height) and Grade 5: 80.1 - 100% (Very High).

RESULTS AND DISCUSSIONS

1. Fifth Traps used in Sumbul Coffee Plantation, Dairi district

Five traps for detecting of pests in Sumbul coffee plantation, Dairi district can be seen in Table 1. From the fifth traps used stated that the used of a Yellow Trap (YT) obtained the highest number of pest of coffee plantations collecting of 108 individuals, followed by the use of Red Trap (RT) as much as 94 individuals and 84 individuals were collected by Attractants Trap (AT). While the lowest recorded from sweep (83) and fit fall trap (62). The effectiveness test of fifth traps presence as shown in Table 2.

Table 1. The traps used to detect pests of Sumbul coffee plantation, Dairi

Order/Family	Sweep Net (SN) (AT)				Fit Pall Trap (FT)				Yellow Trap (YT)				Red Trap (RT)				Atractant Trap			
	1a	1b	1c	Ttl	1a	1b	1c	Ttl	1a	1b	1c	Ttl	1a	1b	1c	Ttl	1a	1b	1c	Ttl
Hemiptera																				
Corixidae	0	0	1	1	1	0	1	1	1	0	1	2	1	0	0	1	1	1	0	2
Pentatomidae	0	0	0	0	0	1	0	1	0	0	1	1	1	0	0	1	0	1	0	1
Reduviidae	0	1	0	1	0	0	1	1	1	0	1	2	0	1	0	1	1	1	1	3
Hymenoptera																				
Braconidae	0	0	0	0	0	0	1	1	0	1	0	1	0	1	1	2	0	0	1	1
Formicidae	2	3	4	9	3	4	2	9	2	3	4	9	2	1	3	6	2	4	2	8
Halictidae	1	1	0	2	0	1	0	1	0	1	0	1	1	0	0	1	0	1	1	2
Ichneumonidae	2	1	0	2	0	1	0	1	0	1	0	1	1	0	0	1	0	1	1	2
Pompilidae	0	0	1	1	1	0	0	1	1	0	1	2	0	1	0	1	1	1	0	2
Vespidae	2	2	1	5	2	1	2	5	2	3	2	7	2	2	1	5	3	2	1	6
Diptera																				
Asilidae	2	2	2	6	1	2	3	6	2	1	2	5	1	1	1	3	2	1	1	4
Agromyzidae	1	1	1	3	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1
Chrysopidae	0	1	1	2	1	1	1	3	1	1	1	3	1	0	1	2	1	2	2	5
Culicidae	1	0	0	1	1	1	0	2	1	1	1	3	1	0	1	2	1	1	1	3
Syrphidae	0	1	1	2	1	1	1	3	1	1	1	3	1	0	1	2	1	2	2	5
Tipulidae	0	0	1	1	0	1	0	1	1	1	1	3	2	1	1	4	1	1	1	3
Blatodea																				
Blattellidae	1	1	0	2	2	3	4	9	1	0	0	1	1	0	1	2	1	0	1	2
Homoptera																				
Cicadellidae	0	0	1	1	0	1	0	1	1	1	1	3	1	2	1	4	0	0	1	1
Coccidae	1	1	0	2	1	0	1	1	2	1	1	4	0	1	1	2	1	0	0	1

Delphacidae	0	1	1	2	0	0	1	1	1	1	0	2	0	2	1	3	1	1	0	2
Isoptera																				
Rhinotermitidae	1	0	1	2	1	0	0	1	1	2	0	3	1	1	0	2	0	1	0	1
Lepidoptera																				
Noctuidae	1	1	1	3	0	1	0	1	0	1	1	2	0	1	1	2	1	0	1	2
Papilionidae	1	0	0	1	0	0	1	1	1	1	0	2	0	1	0	1	0	1	0	1
Coleoptera																				
Chrysomelidae	1	1	1	3	1	1	0	2	2	0	1	3	1	1	1	3	0	1	1	2
Coccinellidae	0	0	1	1	0	0	1	1	1	1	1	3	1	1	0	2	1	0	0	1
Scarabidae	2	2	2	6	1	0	0	1	2	1	1	4	2	1	1	4	2	1	2	6
Scolytidae	6	5	6	17	0	0	0	0	6	0	14	29	7	0	7	20	7	6	12	24
Dermaptera																				
Chelisidae	0	0	0	1	0	0	1	1	0	1	2	0	1	0	1	0	1	1	1	2
Orthoptera																				
Acrididae	1	1	1	3	1	0	0	1	1	1	1	3	1	0	1	2	1	0	1	2
Gryllidae	1	0	0	1	0	0	1	1	1	0	1	2	0	0	1	1	1	0	1	2
Tettigoniidae	1	0	1	1	0	0	0	1	0	1	0	1	1	1	0	0	0	1	1	1
Total				SN= 53				PT= 62				YT= 106				RT= 94				AT= 94

Table 2. Effectivity test using fifth net on distribution of *H.hampei* in Sumbul coffee plantation

Tools (net)	Sumbul District
Sweep Net (SN)	P=0.023**
Pit Fall Trap (PT)	P=0.066
Yellow Trap (YT)	P=0.016**
Red Trap (RT)	P=0.018**
Acid chlorgenic Attractants (AT)	P=0.011**

While the number of individuals in the most recorded from Sumbul village consist of Family Asilidae and Coccinellidae, each in one individual. Because in the ecosystem used monoculture, the insect difficult to find a suitable food source and environment (Ryanto, 2007). From the observation in the field recorded traps mounted as high as 0.5 m above the canopy of coffee plantation after trapping, imago male CFB will be interested to come so caught and dead, suported by Wahyudi (2011). Because this condition, the assumption which pheromone attracts only male insects (Priyono 2009), most likely not having a significant effect on the intensity of CFB attacks, so although it is proven to catch large quantities of CFB pests, however its effectiveness to reduce attack rate and pest damage CFB in the field needs to be studied further.

From various research results indicate that extract the material natural plants can also be used as pullers in trapping CFB. Rya (2010), who got the result that interest adult insects of Caccao Fruit Borrer (CaFB) contained in the treatment of coffee leaf extract with a concentration of 5% higher in attracting of CaFB than concentration 2.5%. The utilization of cocoa fruit aged 3-4 months to the extraction process is considered less effective than coffee plantation only need two months can produce. The farmers require it enlargement of fruit to take the seeds as a result of production.

According to Siregar (2016b), Situmorang (2013), Tambunan, (2013) and Untung (2010) which states that the index diversity is a mathematical representations to ease in analyzing information the number of types of indvidu and how number of individuals species present in the area. The cause of the difference in value index diversity in addition supported by the availability of nutrients for insects, fertilizing, habitat suitability and environmental as well as the flora and fauna heterogeneous with the discovery of crop intercropping such as corn, peanuts, cassava, and bananas so that insects present in more diverse. The score of diversity (H') varies with the medium category, namely H'=1.98 (in Sumbul village). This is according to Siregar (2016c) and

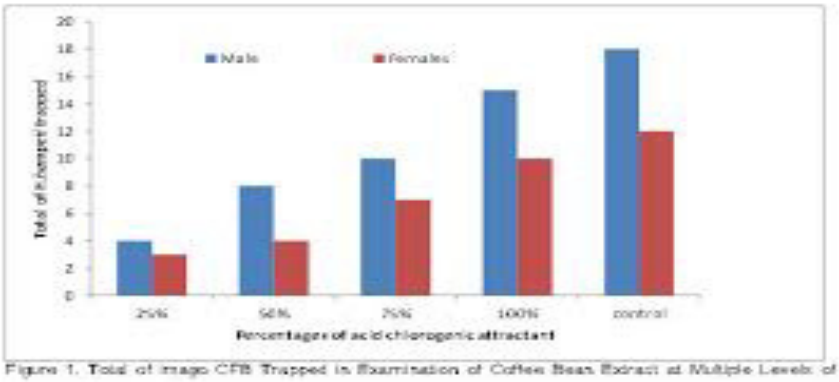

Figure 1. Total of imago CFB Trapped in Examination of Coffee Bean Extract at Multiple Levels of Concentration

Table 2. Percentage and interest classes of CFB imago trapped in test of coffee bean extract

Treatments (acid chlorogenic attractant)	Percentage of interest	Interest class	Categorized
25%	75.6%	Class 4	Height
50%	64.50%,	Class 3	Enough
75%	50.13%	Class 3	Enough
100%	35.40%	Class 2	Medium
Control	35.14%	Class 2	Medium

Wirdiputra (2014) which states increasingly heterogeneous an increasingly complex physical environment of flora and fauna communities in one place and the higher the diversity of species.

Effectivity test uses fifth of traps (sweep net, fit pall trap, yellow trap, red trap, attractant trap) on distribution of H.hampeii showed in Table 2. The most effective tools for controlling pests, especially of CFB in the coffee plantation recorded from using the acid chlorogenic attractants trap (P=0.011**), followed by yellow trap (P=0.016**), and red trap (P=0.018**).

2. Interest of Imago CFB in Various Concentrations of Coffee Bean Extract

The experimental results of interest at various concentration levels indicate that the extract of coffee beans can be attractive to the imago of CFB. Tests of various concentrations showed that at concentrations of 25% and 50% attracted and trapped more adult insects compared used to 75%, 100% concentration and control such as showed by Figure 1.

Table 2 shows the percentage of interest of CFB imago which is trapped in coffee seed extract test in the highest coffee plantation of Sumbul at 100% chlorogenic acid attractant concentration equal to 75.6%, followed by concentration 75% 64.50%, 50% concentration 50.13% and 25% concentration equal to 35.40% with the criteria as can be seen in appendix (Table 2).

The amount of imago CFB contained at 25% concentration causes the level of preference of adult insects CFB at this treatment is the highest. Then, that is similar categorized between concentration 50% and 75% with values are 64.50% and 50.13% (class3) and the lowest recorded from control 25,14%, (Class 2, medium). In coffee beans contain some chemical compounds, among others, caffeine, trigonella, protein, carbohydrates, aliphatic acids, chlorogenic acid, fats, glycosides, minerals, and volatile components (Shondhaimer, 1958; Sri dan Yusianto 2005; Shukla *et al*., 2011). Because off these chemicals, chlorogenic acid acts as an attractant compound to the imago CFB. This is according to Renwick and Chew (1994) and Siregar (2016c), Chlorogenic acid in addition to acting as an antioxidant in humans, is also attractive to insects.

Coffee bean extract has more color concentration than fruit coffee extract coffee, as well as the viscosity of the extract itself. This is because chlorogenic acid in coffee beans is very high and can reach 12 percent by weight (Salisbury, 1995). Density in coffee bean extracts due to oxidation of chlorogenic acid followed by polymerization (a combination of monomermonomers) led to the formation of quinones that caused the discoloration of dark chocolate (Hatanaka *et al*., 1999). But the least amount of interested

imago still influenced by several factors, among others, environmental conditions and adhesives used. This is in accordance with the opinion of Morallo-Rejesus (1986) in Mustafa (2005) that secondary metabolite compounds found in plants or from plants will easily decompose.

CONCLUSIONS

Almost 10 orders, 30 families with 30 genera are collected of ditribution insects on coffee plantation in Sumbul village, Dairi district district. The highest individual found in Sumbul from Families Scolytidae (*H.hampei*, 36 individuals), followed by Family Formicidae (*Formica* sp, 19 individuals) and the Family Vespidae (*Dolochovespula* sp, 12 individuals), compared with total individuals recorded in Sidikalang consists of Scolytidae (41 individuals), Vespidae (14 individuals) and Formicidae (12 individuals). The score diversity (H') varies with the very good diversities category, namely H'=2.26 (in Sidikalang district) and H'=1.98 (in Sumbul village). The most effective for controlling pests of CFB in the field of five tools such as *Yellow Trap*/YT (P <0.019 **); followed by *Attractant Trap*/AT; *Red Trap*/RT; *Sweep Net*/SN; and *Pit Fall Trap*/PT.

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REFFERENCES

AAK (2008). Cultivation of coffee crops. Publisher Kanisius, Yogyakarta.

Center for Assessment and Development of Agricultural Technology (CADAT) (2008). Ministry of Agriculture Republic of Indonesia. Jakarta.

Firmansyah AP, Sjam S, Dewi VS (2013). Coffee bean extract for cacao fruit borer attractant for imago *C. cramerella*. UNHAS. Makassar.

Goddess VS (2007). Coffee plant resistance mechanism against Coffee Fruit Borrer (CFB) (*Conopomorpha cramerella*).

Harborne JB (1987). Phytochemical methods. A modern way guide to analyzing plants. The second issue. Publisher ITB, Bandung.

Harborne JB, Herbert B, Gerard PM (1970). Phytochemicals dictionary A hand book of bioactive coumpounds from plants. Second edition. Taylor and Francis, Ltd.

Hatanaka T, Choi YE, Kusano T, Sano H (1999). Transgenic plants of coffee (*Coffea canephora*) from embryogenic callus via *Agrobacterium tumefaciens*. Mediated transformation Plant Cell Rep.19: 106-110.

Herawati A, Asep S (2013). Effect of chlorogenic acid Lampung robusta coffee against expression of Cyclin D1 and Caspase 3 In Cell Lines HEP-G2. Research Centre, Universitas Lampung. Lampung.

Isyana B, Ivanova O (2011). Carrot's resistant to carrot fly and carrot weevil and ways to increase it (In Russian). Plant Protection Research Institute (St. Petersburg)

James DG (2007). Futher field evaluation of synthetic herbivores-induced plan volatiles as attractants for benificial insect. J. of Chemical Ecology. 31 (2): 481-495.

Khairati N (2012). Effect of coffee arabica sales in the form of fruit harvest (Cherry red) against in economic Arabica coffee growers in Tanjung Beringin, Dairi district. USU. Medan.

Laila MSI, Nurariaty A, Annie PS (2011). The concept of integrated pest management applications for pest control of coffee fruit powders (*H. hampei*). Journal Fitomedika. 7 (3): 162 – 166 (2011).

Malau SP, Raja LB, Naibaho B, Sumihar STT, Simanjuntak R (2012). Study about influence of vegetable natural attractant local and pest trapping made for coffee fruit borer in North Sumatra. Research and Development of North Sumatra Province, Medan.

Moralla-Rejesus B (1986). Botanical insecticides againts diamondback Moth. Proceedings of the First Int. Workshop.

Mustafa B (2005). Study of fruit coffee growing as a control method of Coffee Fruit Borrer (CFB) *Conopomorpha cramerella* Snellen (Lepidoptera: Gracillariidae). South Sulawesi Plantation Office. ISBN: 979-95025-6-7.

Nugroho BA (2015). Coffee fruit borer to control (*H. hampei*) on coffee plant using pheromones. BBPPTP, Surabaya.

Renwick JAA, Chew FS (1994). Oviposition behavior in Lepidoptera. Annu. Rev. Entomot. 39:377-400.

Riyanto (2007). The density, distribution patterns and role ants on plants around residential neighborhood. Journal Research Science 2 (10): 241-253 Robinson, Trevor. 1995. High Organic Plant Content, Kokasih Padmawinata Translation. Bandung. Bandung ITB Publisher.

Shukla K, Shailendra, Tiwari VK, Sushma R, Tewari IC (2011). Studies on synthetic and biological activity of some new triorganotin (IV) carboxylates. ISSN: 2230-9314 & E-ISSN: 2230- 9322. Bioinfo Publication 1 (2): 10-19.

Siregar AZ (2016a). Types pests of coffee plantions. USU. Medan.

Siregar AZ (2016b). Bio-ecology of *H.Hampei* in coffee plantation in Sumbul and Sidikalang Districts, Northern of Sumatera, Indonesia. Int.J.Adv.Res. 4(11): 2051-2058.

Siregar AZ, Dewiyana H (2016c). The use of traps to detect *Hypothetamus*
Hampei in coffee plantation in Dairi district, North of Sumatra, Indonesia. International Journal of Scientific and Technology Research 5 (10): 217-220.

Situmorang TS (2013). Sigarar utang coffee from Sumatera Utara. Section Plantation Seed and Plant Protection (BBPPTP). Meda.

Sondheimer E (1958). On the distribution of caffeic acid and the chlorogenic acid isomers in plants. Arch. Biochem and Biophys. 74: 131-138.

Tambunan GR (2013). Biodiversity index insect type in coconut planting of palm (*Elaeis guineensis* Jacq.) in gardens in Helvetia PT. Perkebunan Nusantara II. Journal Agrotecnology 1 (4): 1081-1091.

Tice R (1998). Chlorogenic acid [327-97-9] and caffeic acid (331-39-5): Review of toxicological literature. North Carolina : ILS.

Untung K (2010). Book of fundamentals sciences plant pests. Department of plant pests and diseases. Faculty of Agriculture UGM, Yogyakarta.

Wahyudi T (2011). Complete coffee guide. Niaga Swadaya Publisher (online).

Waniada C (2010). Testing of coffee fruit extract as stimulant imago fruit snacker (*Conopomorpha cramerella* Snellen) on chocolate plantation (*Theobroma cacao* L). Hasanuddin University, Makassar.

Wardojo S (1980). The cocoa podborer: major hydranceto development. Indonesian Agricultural Research & Development Journal. 2: 1-4.

Wirdiputra S (2014). Antraktan coffee fruit borer in pest environmental friendly. Coffee and Cocoa Research Center Indonesia, Jember, indonesia.