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# Ratio of Coffee Pest Attack (*Coffea Arabica* L) In Place Management and Height System in Aceh Tengah District

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***Abstract*** : *The aims of the study were to determine the comparison between coffee plant management systems and altitude against pest attacks. This study used a 3 × 2 factorial randomized block design (RBD) with 5 replications, the factors that were tried were. Altitude 3 levels namely, K1: 800-1,000 meters above sea level, K2: 1,000-1,200 meters above sea level, K3: 1,200-1,400 meters above sea level. The management system consists of 2 levels, namely: O: Organic, N: Non-organic. This research was conducted in Aceh Tengah District. This research began from July to September 2016. The height of the place and the management system of coffee plants influence the intensity of PBKo pests and there is an interaction between the height of the place and the management system of coffee plants.*

***Key Words****: altitude, organic, non-organic, PBKo, coffee.*

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## I. Introduction

Coffee is the most important export commodity in global trade, such as Gayo Mountain Coffea (GMC) which has a very good quality and flavor so as to get market opportunities in the International. Coffee is also an agent of development that has a real contribution to the Indonesian economy, namely as a foreign exchange earner, producer of industrial raw materials, sources of income and employment (Ditjenbun, 2008).

Coffee cultivation is generally managed intensively to spur production, this cultivation practice is usually combined with the use of fertilizers and chemical poisons (pesticides, fungicides, nematicides, and herbicides) that threaten the preservation of ecosystems and disruption of biodiversity if not managed properly, such as pest resistance, pest resurgence , leaving residue on the product, and danger to users (Ramlan et al., 2010). Constraints that are often faced in increasing the production of coffee plants are pests and diseases. Untung (1993) one of the most important pests that commonly attacks coffee plants is coffee borer (Hypothenemus hampei) which can reduce yields up to 85% which causes large losses, both in quantity and quality.

In the last decade organic farming systems have emerged as an alternative to overcoming the crisis of modern agriculture, which is aimed at maintaining biodiversity and soil conservation. This farming system is based on reducing residues or recycling residues from surrounding land (Hairiah et al, 2003), with intensive human intervention to utilize land and increase yields based on ecological principles (Sutanto, 2002).

In organically managed coffee plantations, there is a tendency to combine coffee with nitrogen-fixing shade-retarding plants with microbial decomposing organic matter which is then used by plants as fertilizer, shade and also to maintain parasitoid habitat which is the key to successful biological control (Kruess & Tscharntke, 1994). The wealth and structure of the Hymenoptera parasitoid in the area of organically managed coffee plantations is higher compared to conventional systems (Syukur, 2015). This has a 'domino effect' on controlling insect hamadi in the field (Bernays, 1998).

Scientific information about the types or groups of associated insect pests has not been well documented (Tuck et al., 2003). This is important to know because there is a special relationship between insect pests and their natural habitat and enemies (Rohrig et al., 2008), and their implications for damaging plant activities. Insect pests in general will have different adaptability and are very selective in choosing places with abundant host plants, including patterns of environmental management (Coley & Luna, 2000). This has major implications for its population on the ground.

Potential insects as pests are often ignored in efforts to develop coffee plantations. This results in very limited information or data about it. In this regard, a planned research is needed to build a database for pest management needs in the future. This research is concentrated to see the relationship between the management patterns of coffee gardens (Coffea arabica L) Organic and Conventional and its dominance. Based on the description above, it is necessary to observe the types of main pest insects in the two coffee plantations that are managed differently, so that they can provide a specific picture of the suitability of the place for pest insects in coffee plantations in Aceh Tengah District.

## II. Material And Methods

This study used a 3 × 2 factorial randomized block design (RBD), the factors that were tried were: altitude consists of 3 levels namely, K1: 800-1,000 meters above sea level, K2: 1,000-1,200 meters above sea level, and K3: 1,200-1,400 meters above sea level. The management system consists of 2 levels, namely: O: Organic, N: Non-organic. Thus there are 6 treatment combinations with 5 replications. Thus this study consisted of 30 experimental units. This research has been carried out at community coffee plantations in Aceh Tengah District from July to September 2016.

**Materials and Research Tools**

The material used in this study was coffee fruit taken from coffee plantations, raffia ropes, bamboo poles, paper labels, plastic bags. The tools used include Global Positioning System (GPS) shoes, Thermometer, Hygrometer, boots, machetes, small buckets, basins and stationery.

**Procedure methodology**

The tool used in this study is GPS to measure altitude and select two expanses of coffee plantations that are managed organically and non-organically, including: a) General conditions of research sites such as geographical location, area and boundaries of the study location, b) Factors environment, which influences the growth of plants such as shade plants, and the age of the sample plants. The research plot is 1 Ha with a total sample of 20 coffee plants. Sampling and taking were carried out every two weeks five times Fruit samples were taken from each sample plant randomly as many as 200 pieces / stems and calculated the intensity of attack from the fruit observed with the characteristics of hollow fruit. The factors that will be observed in this study include: The intensity of the attack of coffee borer (*Hypothenemus hampei*), calculated from each sample plant taken 200 copies per one observation with the sampling method used Stratified random sampling, carried out by dividing the sample plant parts into several parts then randomly taking fruit for each - each part (Crabb *et al.*, 1994). Then comparisons are calculated between the affected coffee fruits and the total amount of coffee taken from one sample plant

**Statistical analysis**

The results of this research are analysis of arrangements randomized block design (RDB) and if a difference is continued with a least significance different (LSD) test, The level $P < 0.05$ was considered as the cutoff value or significance.

## III. Results

Table no 1 Shows intensity of Coffee Fruit Borer Attack (H. hampei) F test results on the analysis of variance showed that the height of the place affects the intensity of PBKo pest attacks. This can be seen in Table 1 below.

**Table no 1.** PBKo pest attack intensity at each altitude 800–1,000, 1,000–1,200 masl, 1,200–1,400 masl in coffee plantations managed by organics and non-organics.

| Treatment | Attack intensity (%) | | | | | Average |
|---|---|---|---|---|---|---|
| | I | II | III | IV | V | |
| Organic | | | | | | |
| $KO_1$ | 23.95 | 30.90 | 15.85 | 18.35 | 21.45 | 22.10c |
| $KO_2$ | 14.10 | 11.95 | 9.30 | 10.85 | 11.45 | 11.53a |
| $KO_3$ | 7.40 | 16.35 | 8.00 | 8.90 | 8.35 | 9.80a |
| $BNT_{0,05}$ | | | | | | 2.13 |
| Non Organic | | | | | | |
| $KN_1$ | 20.20 | 32.95 | 15.20 | 20.85 | 24.05 | 22.65c |
| $KN_2$ | 14.10 | 44.10 | 10.35 | 14.95 | 13.35 | 19.37c |
| $KN_3$ | 5.40 | 24.25 | 9.20 | 12.90 | 11.90 | 12.73b |
| $BNT_{0,05}$ | | | | | | 2.72 |

Note : the numbers followed by different letters in the same column are significantly different at the lowest probability level of 0.05.

Table no 2 Shows the results of observations on the intensity of the PBKo pest attack in observations I, II, III, IV and V can be seen in Appendix 1, there are variations in the intensity of the attack of the coffee fruit hoist at various altitudes and coffee plantation management systems. The results of variance indicate that the management system of coffee gardens organically and non-organically there is a very significant difference in the level of PBKo pest attacks. This can be seen in appendix 3 and table 2 below ...

**Table no 2.** PBKo pest attack intensity in organic and non-organic coffee plantations at each altitude of 800-1,000, 1,000-1,200 masl, 1,200-1,400 masl.

| altitude | Attack intensity (%) | |
|---|---|---|
| | **Organik** | **Non Organik** |
| $K_1$ | 22.10 | 22.65 |
| $K_2$ | 11.53 | 19.37 |
| $K_3$ | 9.80 | 12.73 |
| **Total** | 43.43 | 54.75 |
| **Average** | 14.47 | 18.25 |

Note: the numbers followed by different letters in the same column are significantly different at the lowest probability level of 0.05

## IV. Discussion

The results of this study indicate the intensity of the highest coffee borer attack at an altitude of 800-1000 m above sea level which is very significantly different with a altitude of 1,000-1,200 m above sea level and 1,200-1,400 m above sea level. But the intensity of the PBKo attack was not significantly different between the altitude of 1,000-1,200 m asl and the altitude of 1,200-1,400 m asl. Overall the results of this study indicate the lowest attack is found at an altitude of 1,200-1,400 m asl both in coffee plantations that are managed organically and inorganically. This shows that coffee borer pests (PBKo) have the ability to adapt to an area with a certain height, where the PBKo can live and develop optimally. According to Gillot (1982) in general the development and reproduction of insects is greatly influenced by a variety of abiotic factors, one of which is the temperature which can cause changes in the physiology of insects and the ability to search for food.

Basically, insect metabolism is strongly influenced by environmental temperatures that make it able to survive and directly affect the rate of birth and death (Rockstein, 1973), and indirectly the temperature affects the abundance of insects (Ysvina, 2010). This can be observed from the results of this study which shows that the altitude of 800-1,000 meters above sea level is the highest intensity of PBKo attacks as much as 22.10% and 22.65%, followed by the altitude of 1,000-1,200 meters above sea level as much as 11.53% and 19.37%, and the lowest attack at altitude 1,200-1,400 masl as many as 9.80% and 12.73%, this shows the intensity of PBKo attacks lower and is followed by a higher altitude. The height of a place is very closely related to the ambient temperature, where every 100 meters rise from sea level at normal temperature will decrease by 0.60oC, but for dry air the temperature drops by 1oC (Purwantara, 2015).

Table 1 shows that the higher the height at which the intensity of PBKo attacks is also lower, this illustrates the sensitive response of PBKo pests to their environment. In accordance with the opinion of Schowalter (2000) that insects can change their behavior in response to the ups and downs of environmental conditions or environmental changes. Insects, especially those that can fly and move to avoid ups and downs in temperature, humidity, chemicals or other abiotic factors to avoid adverse conditions. The results of the study of Capinera (2012) altitude affect the difference in temperature, humidity, and wind that affect the spread of insects.

According to Barerra (2008), PBKo's life cycle is influenced by temperature. The lower the temperature, the longer the life cycle. At 27oC, the beetle's life cycle is 21 days, 22oC is 32 days, and 19.2oC is 63 days. The condition of coffee plantations in Sumatra is classified as a wet area and most have climate types B and A (according to Schmidt and Ferguson climate types). In highland areas> 1,200 meters above sea level the PBKo insects will be hampered, so that in these areas the intensity of PBKo attacks is usually low (Wiryadiputra, 2007).

The development of PBKo is greatly influenced by the temperature and availability of coffee fruit. PBKo insects can live at temperatures of 15-35 ° C, the optimal temperature for egg development between 30 ° C-32 ° C and for larvae, pupae and adults between 27-30 ° C. Female insects can broach coffee fruit between 20-33 ° C, at temperatures of 15 ° C and 35 ° C female insects fail to broach coffee fruit or are able to broach coffee fruit but do not lay eggs (Jaramilo et al., 2009). It is known from observations of temperature at an altitude of 800-1,000 masl average temperature 28$^0$C, then at an altitude of 1,000-1,200 masl average temperature of 26$^0$C, and at an altitude of 1,200-1,400 masl average temperature of 23$^0$C during the day and ranges between 18-19$^0$C temperature at night, this is in accordance with the opinion of Sangadji (2001) which states that changes in temperature from daytime to night range between 3-5 ° C.

Decrease in insect population can be caused by a decrease in fecundity due to a decrease in temperature (Hodkinson, 2005). This is supported by the results of research by Hoiss et al. (2012) which states that the number of insect species decreases with increasing latitude or altitude due to environmental influences. In addition, higher places can slow down insect reproduction so that the number of generations and the number of insect populations tends to be less (Duyck et al. 2010). The higher the temperature, the shorter the life cycle (Aser, 2011). In areas with an altitude of 450 m above sea level, the life cycle is 25 days. While at an altitude of 1,000 m above sea level, for the development of eggs to adulthood takes 33 days. The results of the study of Gay et al. (2006) showed that the attack rate of coffee fruit borer (Hypothenemus hampei) will increase with increasing temperature. Jaramillo et al. (2009) predicts that any increase in temperature of 1oC will result in H. hampei developing faster, resulting in a higher number of generations for each harvest season and expanding the range of spread. Syarkawi et al (2015) added that temperature is the most important determinant of insect activity in finding food sources. Weather factors play an important role in the life cycle of insects. Where on a broad boundary, weather factors affect the spread and abundance, which is one of the factors causing the emergence of pest attacks. Weather factors can affect everything in the insect community system, including physiology, behavior, and other biological features, both directly and indirectly. Weather factors can be separated such as temperature, humidity, light, and air / wind movement (Ysvina, 2010).

Observed from table 2 above there is a significant influence of the coffee plantation management system that is managed organically and non-organically with the intensity of PBKo insect attacks, where the highest attacks are found in coffee plantations that are managed non-organically with an average of 18.25%, while on the estate organically managed coffee is only 14.47%. This is allegedly because the non-organic coffee cultivation system in practice is inseparable from the use of fertilizers, pesticides and herbicides which can cause pest resistance and resurgence (Ramlan et al., 2010). While the organic management system prioritizes soil conservation and maintaining biodiversity, by utilizing nitrogen-fixing shade species which are then used by plants as fertilizer, while maintaining parasitoid habitat as a key to successful biological control (Kruess & Tscharntke, 1994). This is consistent with the results of the study of Syukur (2015) the wealth and structure of the Hymenoptera parasitoid in the area of coffee plantations that are managed organically is higher than the nonorganic system, which provides a 'domino effect' on pest control in the field (Bernays, 1998).

In non-organic coffee plantations which are managed by chemical fertilizer treatment, the PBKo population tends to be higher than organic treatment. This is because the use of chemical fertilizers will continuously indicate the condition of the plants to be more fertile, the leaf color becomes greener, the leaf size becomes larger, the fruit becomes sweeter and more brightly colored and the stems become soft and runny (seculent) so that they fall easily and are easily attacked by pests (Imgaagro, 2014). In the treatment of organic fertilizers, the population tends to be lower, this is because the condition of the plants becomes less attractive to pests (Prasetyo, 2006).

In accordance with the results of Yulia's study (2016), where the treatment of organic fertilizer plus nano chitosan showed the lowest damage intensity, while in chemical treatment showed the highest damage intensity. Plants that are excess of chemical fertilizers show a succulent dark green color, which causes plants to be sensitive to pests and easily collapse (Hardjowigeno, 1995). Yulia (2016) added that most pest insects to be able to find their host rely on visual signals (color, shape, and size) and chemistry (aroma), this is what causes pests to like plants that have a dark green color.

## V. Conclusion

1. The height of the place and the coffee plantation management system affect the intensity of the attack of coffee fruit borer (PBKo).
2. The highest intensity of PBKo attacks is found at an altitude of 800-1,000 MDPL with non-organic management systems and the lowest attack is at altitude of 1,200-1,400 MDPL with organic management systems.

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