Variation of Food Preference of Black Ants (*Dolichoderus thoracicus*)
Smith and Four Antagonistic Ants in Cocoa Plantations in Indonesia

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Keywords: Dolichoderus thoracicus, antagonistic ants, food preference, cocoa pod borer

Abstract: This study was carried to determine the variation of food preferences of black ant, *Dolichoderus thoracicus* Smith, and four antagonistic ants; *Oecophylla smaragdina* (Fabricius), *Anoplolepis gracilipes* (Jerdon), *Techynommyrnx* sp. (Smith) and *Crematogaster* sp. (Smith), (Formicidae: Hymenoptera) in cocoa plantations. Black ant is used in controlling cocoa pod borer (CPB). However, in carrying this biological control of CPB, antagonist ants caused difficulty in establishing black ants. Naturally, black ants are attracted to honeydew produced by mealybug (*Cacaenococcus hispidus*). Six variations of food preference were tested i.e; honey, dried salted fish powder, sugar powder, dried egg powder, syrup, and water. *Dolichoderus thoracicus*, *O. smaragdina* and *Crematogaster* sp. preferred salted fish and egg powder while *A. gracilipes* preferred honey and syrup and *Techonomymnx* sp. preferred sugar powder and honey. The food preferred by antagonists can be used as the components of incorporated into the toxic bait in controlling these ants. Baiting is an efficient method of controlling the antagonistic ants, however, the black ant, *D. thoracicus*, also consumed similar food as the antagonist ants. From the study, salted fish and egg powder could be made as an alternative food of *D. thoracicus* if the cocoa plantations lack mealybugs.

1 INTRODUCTION

Black ants (*Dolichoderus thoracicus* Smith) (Hymenoptera: Formicidae) have been known as biological agents in controlling Cacao Pod Borer, *Conopomorpha cramerella* Snellen (Lepidoptera: Gracillariidae) in a cocoa plantation in Indonesia (Kalshoven, 1981; Ho, 1994; Saleh, 2011.). Cocoa Pod Borer is difficult to be controlled due to the larvae ≥60% of its life cycle is in a cocoa pod and the impact is the cocoa production reduce more than 80% (Wardojo, 1980). High black ant populations are required in controlling attacks of cocoa pod borer (Saleh, 2007). Ants are one of the dominant communities of cocoa fauna (Azhar, 1985). They have been reported to influence the cocoa fauna structure and can be used a control agent for some of the cocoa pests (Entwistle, 1972; Azhar, 1985). There are more than 16 species of ant found in a cocoa plantation in Bah Lias Estate, (Saleh, 2011). However, four species are considered serious antagonists to *D. thoracicus*. There are weaver ants or green tree ants, *Oecophylla smaragdina* (Fabricius); long-legged ant, *Anoplolepis gracilipes* (Jerdon); white-footed ant, *Techonomymnx* sp (Smith) and acrobat ant, *Crematogaster* sp (Smith). They belong to Order Hymenoptera in the Family of Formicidae (Khoo & Chung, 1989; Saleh et al. 2007). Based on their dominance, these ant species prefer to inhabit in cocoa plantations (Saleh et al. 2007; Anon. 2009). These antagonist ants compete for the foods and aggressive to drive out black ant from their territories (Entwistle, 1972). Nevertheless, the weaver ant, *O. smaragdina*, is a useful predator for controlling *H. theobromae* and others pests on cocoa trees; however, it is not acceptable in IPM management of cocoa pests because it inflicts painful bites to workers in cocoa plantations and (Way & Khoo, 1991).

Areas to be established with *D. thoracicus* must be free or a few population of antagonistic ants. Suppression of antagonist ants is needed in the establishment of black ant, especially in new areas (Entwistle, 1972; Saleh et al. 2006; 2007). Three out of four antagonist ants (*O. smaragdina, A. gracilipes and Techonomymnx* sp) are severe prevent the establishment of black ant. Practice in the estate, ant antagonists are controlled by the application of Fipronil insecticide (Saleh. 2011; Saleh et al. 2006; 2007). The future control of antagonistic ants could be baiting method which safe to human and cocoa environment. Ants that nest in protected harborage are often unaffected by sprays but will emerge from cryptic, protective habitats to feed on toxic baits. Baits are easy to apply and require no mixing by the applicator. Baits do not unduly affect non-target insect species that are not attracted to the bait matrix, and they can
be placed in containers which only allow access to target species (Warner. et. al. 2004).

The objectives of the study were to determine the food preference of the antagonistic ants and will not impact to *D. thoracicus* population.

## 2 MATERIAL AND METHODS

The studies were conducted in June 2006 to December 2007 in the cocoa plantation located in Bah Lias Estate PT.PP.London Sumatra Indonesia Tbk (Lonsum). Bah Lias Estate is located at 99° 15' 36" - 99° 21' 36" East and 3° 8' 24" - 3°13' 12" North, in the province of North Sumatera, Indonesia. The altitude of Bah Lias Estate is 32 m above sea level and the distance from Medan is 139 km. The average rainfall at Bah Lias Estate in 2006 and 2017 were 1940 and 1502 mm, with 113 and 94 rain days/year (BLRS. 2006. 2007). The 26-year-old cocoa field which consists of 700 trees and 50 coconut palms as permanent shade per ha was chosen for this study area. The *D. thoracicus* ant was not established for all area and some plots of areas were occupied by antagonistic ants. For this study, a plot for each kind of ants was 400 trees (20x20) which occupied by *O. smaragdina*, *A. gracilipes*, *Techonomyrmex* sp and *Crematogaster* sp, then selected 5 trees sample/plot for placing the food preference.

This study was to determine the kinds of foods preference for 4 antagonistic ants (including *Crematogaster* sp).

The six kinds of foods attractant were tested i.e: honey, dried salted fish powder, sugar powder, dried eggs powder, syrup, and water. The powder of salted fish and sugar and chicken egg were dried under the sun for few days before use and Solution of 10% honey bee and Syrup Kurnia (contains; sugar, citric acid, Karmoisi Cl 14720 and Raspberry aroma, (Syrup. 2014).

Twenty g powder of salted fish, sugar and eggs and 20 ml for the solution of honey and syrup were prepared and placed in a Petri dish of 3.7 cm diameter and 1.0 cm high and then each Petri dish was placed in a larger Petri dish, 9.3 cm diameter and 0.7 cm height.

The experiment design was use Randomized Block Design with five replicates (5 trees were selected in each plot) and six treatments (food preference) for each kind of ants.

The bait (food preference) were placed on the ground 10 - 20 cm from the base of each of their trunks as shown in Figure 1.

![Figure 1. Food baits are placed on ground 10-20 cm from the cocoa trunk.](image)

The population of ants was counted monthly during the observation. The observation started at 07.00 hr and ended at 13.00 hr. There were six hourly observations in each month. At the end of each hour, the Petri dishes were collected and placed separately in a plastic bag and the ants were killed, and all foods were replaced hourly. Then the number of antagonist ants found in the Petri dish was counted in the laboratory. The mean number of ants on each food was analyzed by using one-way ANOVA with SPSS 22 program.

## 3 RESULTS

The result of determining the variation of food preference the black ant and antagonistic ants from June 2006 to December 2007 as shown in Table 1.

### Table 1. Food preference of *D. thoracicus* and its antagonists

<table>
<thead>
<tr>
<th>Food preference</th>
<th>Mean ± SE of ants per bait</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>A. gracilipes</em></td>
</tr>
<tr>
<td>Honey</td>
<td>24.9 ± 1.7 b</td>
</tr>
<tr>
<td>Salted fish (*)</td>
<td>4.8 ± 0.4 d</td>
</tr>
<tr>
<td>Sugar (*)</td>
<td>16.6 ± 1.8 c</td>
</tr>
<tr>
<td>Eggs (*)</td>
<td>4.0 ± 0.3 d</td>
</tr>
<tr>
<td>Syrup</td>
<td>43.9 ± 1.9 a</td>
</tr>
<tr>
<td>Water</td>
<td>0.8 ± 0.0 d</td>
</tr>
</tbody>
</table>

Means in the same column followed by a different letter are significantly different (LSD test, P = 0.05).
Table 1 and Figure 2 indicate that *A. gracilipes* preferred to consume syrup, honey and sugar powder than salted fish powder, egg powder, and water. Statistically, these preferences were significantly different ($F=138.9; P < 0.001$). Among the three most preferred food, *A. gracilipes* preferred syrup the most. *Crematogaster* sp strongly preferred salted fish and eggs powder continuously as depicted and significantly different to others food ($F=108.7; P < 0.001$). *O. smaragdina* showed a strong preference for powder of salted fish and followed by egg powder and other food types such as syrup, honey and sugar powder ($F=466.2; P < 0.001$). *Technomyrmex* sp preferred to eat with a similar amount of sugar, and syrup then followed by honey, salted fish and egg powder. These food preferences were significantly different ($F= 290.7; P < 0.001$). The alternative of food preferred by *D. thoracicus* was salted fish powder followed by egg powder and honey. They were statistically significantly different to sugar powder and syrup and control (water) ($F= 573.2; P < 0.001$).

### 4 DISCUSSIONS

In natural the long-legged ants, *A. gracilipes* feed on honeydew from coccid, jassids, and mealybugs (Entwistle, 1972; Kalshoven, 1981), and the result of this study indicated that *A. gracilipes* preferred to consume syrup, honey. There are sometimes aggressive towards other ant species such as the useful black ant (*D. thoracicus*) in cocoa capturing individuals of the latter species and spraying them with formic acid. The presence of the long-legged ant in cocoa, unlike black ant, does not favor the white mealybugs (Entwistle, 1972; Kalshoven, 1981).

Day (1986) and (Kalshoven, 1981) said that for *Crematogaster* habitually feeds on the sugary substances produced by sucking insects and plants, on animal refuse and are occasionally carnivorous, while this study *Crematogaster* consume more salted fish and egg powder. In actual *O. smaragdina* feed on the honeydew from coccids, Membracidae and Lycaenidae, moreover, they feed on dead animal material and attack living insects (Kalshoven, 1981). It is mostly similar to the result of this study that its preference the salted fish and egg powder. *Technomyrmex* feeds on plant nectars and honeydew, which is a sweet substance produced by many sap-sucking insects such as aphids, mealybugs, and scales, and it is known to protect honeydew producers, which has caused problems in agricultural production in some areas of the world (Warne, et al. 2016). Food of *D. thoracicus*, black ant is largely derived from the honeydew of its mutualism, the mealybug, *C. hispidus* (Ho & Khoo, 1997). Species of mealybugs attended by *D. thoracicus* include *Cataenococcus hispidus, Planococcus lilacinus, Pseudococcus ellisi, and Maconellicoccus hirsutus* (Khoo & Chung, 1989). The black ant also regularly tend the long-tailed mealybug of cocoa (*Planococcus lilacinus*), the green scale (*Coccus viridis*), the whitefly of jambu (*Psidium guajava*), some small tree hoppers (Membracidae) and Psyllidae (Kalshoven, 1981; Azhar, 1988). Kalshoven (1981) added that besides attending the mealybugs, black ants also feed on nectar which produced by flower resinous secretion of bamboo, pollen and fungal fructification. It has been observed that when the mealybug of cocoa is scarce, the black ants also feed on the peel of the fruits of a small weed, wellresses (*Paperomia pellucida*) (Kalshoven, 1981). It is known that the presence of the ants favors the development of white cocoa mealybugs (the survival of these coccids may depend on the ants) and that of green coccid. The mealybugs (which cover the colonies with the papery material) are protected by ants (Ho & Khoo, 1997; Khoo & Ho, 1992; Azhar, 1994).

Baiting is one of the effective control methods widely used in ants, such as yellow crazy ant (long-legged ant), white food ant and acrobat ants (Abbott et al. 2009; Harris,
2009). However, Warner (2003) said that the main requisites for a successful ant bait are 1) Preferred bait base must endure long enough to achieve control, 2) Non-repellent active ingredient, 3) Active ingredient must acts slow enough to circulate within the colony and/or to allow the recruitment of new foragers, 4). Active ingredient must be transferable to nestmates and brood, and 5) Has low mammalian toxicity.

Using baits to control antagonistic ants in the sporadic areas where black ant, D. thoracicus has established well must be carefully decided because the food preference for bait materials will be consumed by black ant. This can be disastrous to the black ant population later on. This study indicates that some the food preferred by antagonistic ants, A. gracilipes and Technomyrmex sp were, namely syrup and sugar powder, while Crematogaster sp and O. smaragdina preferred the powdered salted fish and egg, which was also preferred by D. thoracicus. However, D. thoracicus consumes all of the food preference are tested. The life history of A. gracilipes this species in detail, since it plays an important role in tending pests such as mealybugs, scales and jassids, unlike the black ant (D. thoracicus), this species is therefore considered to be a pest of several crops, such as coffee, cocoa, mango, etc (Saleh, 2011).

5 CONCLUSIONS

Salted fish and egg powder are food preferenced by Black ant (D. thoracicus), O. smaragdina and Crematogaster. For A. gracilipes and preferred honey and syrup, while Technomyrmex, sp preferred sugar powder and honey. D. thoracicus consumes most all food is tested, in consequence, Salted fish and others could be used for alternative food when establishing of black ant especially if the cocoa areas lack mealybug.

ACKNOWLEDGEMENT

The author is thankful to Head of College of Agricultural Sciences Agrobasisnis Plantation (STIPAP) to publish this paper and provide needed facilities. And also thanks to Bah Lias Research Station PT. Lonsum to help and give facilities for this study.

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