Serangga 22(2): 1-14
ISSN 1394-5130 © 2017, Centre for Insects Systematic,
Universiti Kebangsaan Malaysia

THE POTENTIAL OF BLACK ANT *(Dolichoderus* sp.*)* AS A BIOLOGICAL CONTROL AGENTS OF THE COCONUT LEAF BEETLE (*Brontispa longissima*)

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ABSTRACT

The study of coconut leaf beetle infestation, *Brontispa longissima* on palms and the effectiveness of biological agents as a method of control have been carried out in the laboratory. The study involves the effectiveness of potential black ants as biological agents in controlling beetle populations. The results of laboratory studies on the ability of black ant predation on the *B. longissima* found that the percentage of mean beetle are eaten by the group that has the number 100 black ants were higher and significantly different ($P < 0.05$) as compared to group numbers 5, 20, 50 and 75 black ants. In addition, black ants also tend to attack and devour the *B. longissima* larvae and pupa stage compared to adult's beetle via laboratory studies. It can be concluded that the *B. longissima* beetle has a great potential for

causing considerable damage to the coconut tree which could affect coconut palm industry in Malaysia. However, the usage of biological agents as a control method had shown promising results in order to control the beetle infestation in coconut palm areas.

Keywords: black ants, *Dolichoderus sp.*, biological control, coconut leaf beetle, *Brontispa longissima*

ABSTRAK

Kajian mengenai serangan kumbang daun kelapa, *Brontispa longissima* ke atas tanaman kelapa dan agen kawalan biologi sebagai langkah kawalannya telah dijalankan di makmal. Kajian makmal melibatkan potensi semut hitam sebagai agen kawalan biologi dalam mengawal populasi kumbang ini. Hasil kajian makmal terhadap keupayaan pemangsaan semut hitam ke atas kumbang *B. longissima* mendapati peratusan min kumbang yang dimakan oleh kumpulan yang mempunyai bilangan 100 ekor semut hitam adalah lebih tinggi dan berbeza secara signifikan ($P<0.05$) berbanding kumpulan bilangan 5, 20, 50 dan 75 ekor semut hitam. Selain itu, semut hitam juga cenderung untuk menyerang dan memakan peringkat larva *B. longissima* berbanding peringkat pupa dan kumbang dewasa melalui kajian makmal. Kesimpulan kajian menunjukkan bahawa kumbang perosak *B. longissima* berpotensi mendatangkan kemusnahan teruk ke atas pokok kelapa yang mana mampu menjejaskan industri tanaman kelapa di Malaysia. Namun kaedah kawalan menggunakan agen biologi didapati berupaya membunuh kumbang sekaligus dapat mengawal populasi serangan kumbang di kawasan ladang kelapa.

Kata kunci: semut hitam, *Dolichoderus sp.,* kawalan biologi, kumbang daun kelapa, *Brontispa longissima*

INTRODUCTION

Coconut leaf beetle (*Brontispa longissima*) is one of the major insect pests of coconut plantations in many parts of Asia and the Pacific (Singh & Rethinam, 2005 and Stapley, 1973). The Larvae and adult beetles were found to attack and ingest the coconut leaf growth tissue. This attack causes the leaves to become dry and affect the coconut products and the trees have potential to die (Tran, 2007). In Malaysia, the coconut leaf beetle, *B. longissima* was found to attack the coconut plantations and some types of ornamental plants from the palm species.

According Sivapragasam (2007), the uncontrollable population of *B. longissima* beetles can destroy and affect the coconut industry in Malaysia. The use of chemical pesticides is often the preferred choice nowadays for the control of pest populations. This method is preferred by farmers because of its ability to kill insects quickly and effectively (Kelly et al., 2000). However, uncontrolled and frequent uses of pesticides bring up the health concerns to the farmers and consumers (Tran, 2007).

Black ants have identified as potential biological control agents in pest control (Khoo and Ho 1992; Azhar 1989). Black ants or scientifically, *Dolichoderus sp*. is a dominant ant and is often found in coconut trees compared to other ecosystems (Khoo, 1998). While a study conducted by Khoo et al. (1994) found that black ants, *Dolichoderus sp*. regulate the percentage of cocoa pod borer attack in Malaysia up to 72% mortality of pests. Although the role of black ants, *Dolichoderus sp.* as biological control agents have long been known but not many studies conducted on the effectiveness of this predatory beetle pest control populations of *B. longissima.* Information such as the ability and potential predatory ants to ingest the beetle pests should be considered before its use in the coconut region. The study aims to measure the number of black ants that are capable

of attacking and eating various life stages of *B. longissima* pest beetles in the laboratory.

MATERIALS AND METHODS

The effectiveness of predatory black ants towards life stages of beetle *Brontispa longissima*

The black ants, *Dolichoderus sp.* have been cultured in the laboratory for use in this study. Predators were left for 24 hours without food before being placed in a plastic container size (6 mm x 8 mm) in the ratio of 5, 20, 50, 75 and 100 in number. 30 beetles *B. longissima* in stages of larvae, adult male and female have been placed separately in the container with young coconut leaves as a food source for the beetle. Third and fourth stage instar larvae have been used in this study because those stages actively attack and consume the coconut leaves. Each group has been repeated for ten replications and the experiment was held in a day (24 hours). Data has been collected using the observation of number of *B. longissima* that were consumed by predator. Beetle is considered dead if it does not give any reaction to the touch using a soft color brush. Two-way ANOVA analysis used to determine the influence of group ratio and different life stages to the number of dead *B. longissima*. The non-parametric Tukey test was conducted to compare the mean of the factors.

The tendency of predatory black ants to choose the difference of life cycle of beetle *Brontispa longissima* as food

The study was carried out for the tendency of black ant predation on *B. longissima* when all the life stages of the beetles were placed in the same container. A 30 number of each larvae, pupae and adult of *B. longissima* were taken from the laboratory of entomology and put in the container measuring 6 mm x 8 mm. Some pieces of young coconut leaf were placed together in a plastic container as a source of food beetles. Another total of

100 predatory black ants, *Dolichoderus sp.* were left without food for a day before being released into the plastic container containing the *B. longissima.* The experiment was repeated for 10 replications and the number of dead beetles was collected after 24 hours of the experiment. Data was analyzed using one-way ANOVA and the mean value was compared using the Tukey test.

RESULTS & DISCUSSIONS

The effectiveness of predatory black ants on life stages of *Brontispa longissima*

There was significant difference ($F = 152.32$, $df = 2,149$; $P < 0.05$) for the life stages of *B. longissima* that affects the total number of consumed black ants. The highest mean percentage recorded was the larva of *B. longissima* (62.8 ± 2.56) % and significantly different ($P < 0.05$) as compared to the male of *B. longissima* (34.5 ± 1.99) % and the female *B. longissima* namely (36.6 ± 2.56) % (Figure 1).

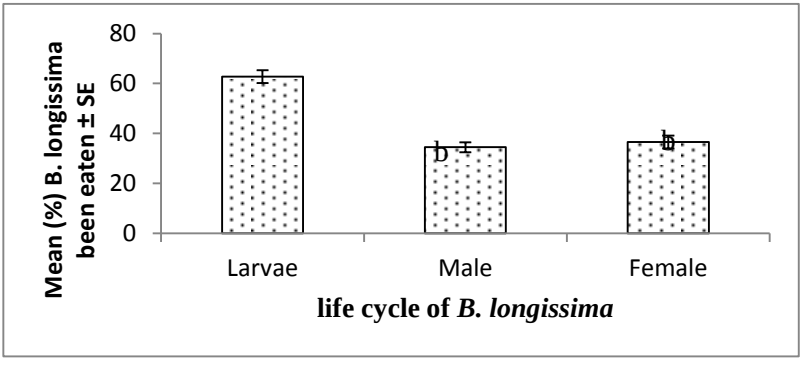

Figure 1. Mean percentage of stage *B. longissima* consumed by black ants

The results show the percentage of victimization effectiveness of larval *B. longissima* that eaten by *Dolichoderus sp*. is more significantly (P <0.05) than in the adult beetles (Figure 5.1). While the adult male and female *B. longissima* showed no significant difference (P> 0.05) in terms of percentage is consumed. According Sunarso (2001), predators attack the larval stage usually considerably compared to the adult *B. longissima*. This situation is due to the body size of adult beetles *B. longissima* was bigger and had a skin structure which is harder than the larva and prevent and delay time-consuming activities Predator prey. In addition, the larvae have a white colors body more attractive than the black ants to attack adult beetles have a black body (Edy et al. 2008).

The study found that different ratio of predator will affect the number of *B. longissima* consumed by black ants (F = 90.05, df = 4,149; P <0.05). The highest mean percentage of *B. longissima* consumed was recorded at a ratio of 100 predators (62.33 ± 3.34) % and significantly different compared to other ratios. This is followed by a ratio of 75 (51.17 ± 3.45) %, the ratio of the 50 (47.0 ± 2.27) % and the ratio of 20 (42.83 ± 2.69) %. The lowest mean percentage *B. longissima* consumed by black ant predator a on a ration 5 black ant as preadator (19.83 ± 2.73) % (Figure 2).

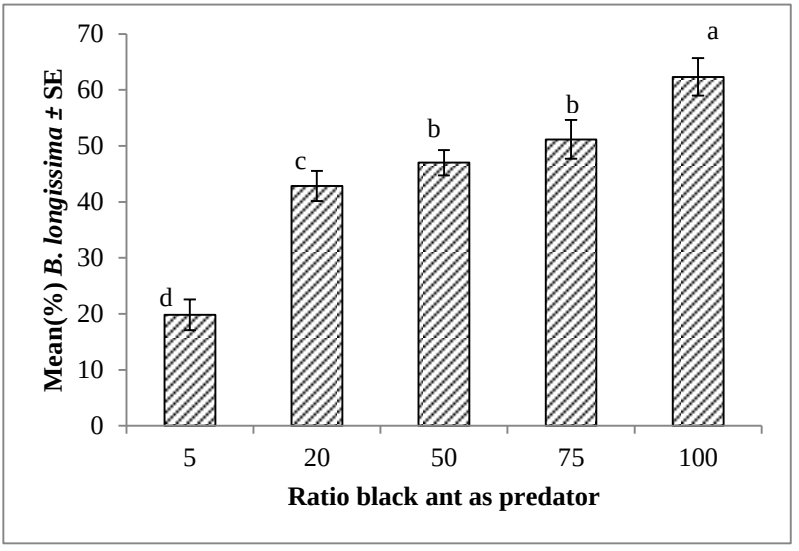

Figure 2. Mean percentage of *B. longissima* are consumed by predatory black ants based on predatory number of groups different

The study also found total predator also affect the numbers of *B. longissima* eaten by black ants. Figure 2 shows an increasing trend in the number of beetles that consumed when the number of predators increases. The ratio of 100 predator black ants recorded the number of *B. longissima* that consumed most significantly ($P < 0.05$) compared with other ratios. This was due to predatory black ants often attack their prey in packs. This is consistent with the nature of the ants that perform activities such as foraging in groups and live in colonies (Klugl 2001; Gordon, 2003). In addition, some previous studies have shown a relationship between the numbers of black ant populations will reduction of the population of insect pests such as pest *Helopeltis* on cocoa (Khoo 1987; Azhar 1992; Saripah & Azhar, 2007). Some farmers in other parts of the country, Vietnam found the presence populations of black ants have managed to reduce the

percentage of pest infestation *Alophia sp.* on sapodilla fruit plants up to 51% (Paul & Nguyen, 2000).

The study also found a significant difference ($F = 2.19$; $df = 8,149$; $P < 0.05$) for the interaction between the life stages of *B. longissima* and predator ratio on the total number of *B. longissima* eaten by the black ants. Overall, the larva of *B. longissima* is the most widely eaten by the black ants. This is evident by the highest mean percentage recorded by the larvae stage of *B. longissima* (84.5 ± 2.83) %. While the ratio of 100 black ants was found to attack and ingest the *B. longissima* more than any other predator ratio. This can be seen when the mean percentage of black ants at a ratio of 5 ingested on the adult male and female *B. longissima* were minimal, each (12.5 ± 2.14) % and (9.0 ± 1.45) %. Male and female adult stages of *B. longissima* also showed no significant difference ($P > 0.05$) in mean percentage ingested by the black ants with ratio of predators (20, 50 and 75 pieces) except at a ratio of 100 predators (Figure 3).

In the meantime, the study shows there is interaction between the beetle *B. longissima* ratio *Dolichoderus sp* ant. Any increase in the number of predators that affect the total number of prey eaten various levels. This also makes the black ants as predators more effectively control the various stages of the pest beetles on palms. No significant differences were found between the numbers of adult *B. longissima* that eaten by ant although the number of predators increases. These results are consistent with Holling (1996) which states components that affect the relationship between predator and prey is characteristic of the victim's role as a mechanism of self-defense as tough skin on the adult beetles in addition to the factors predators in terms of the density of the number and manner of eating predators same there are sharp or tearing. In addition, the black ant species *Dolichoderus sp.* also reportedly attempted to

attack the larvae of various types of insect pests such as pests *Helopeltis* and *Conopomorpha cramerella* than other ant species that *Oecophylla smaragdina, Anoplolepis longipes* and *Crematogaster sp*. (Azhar 1985; Way and Khoo 1992; Gassa 2002).

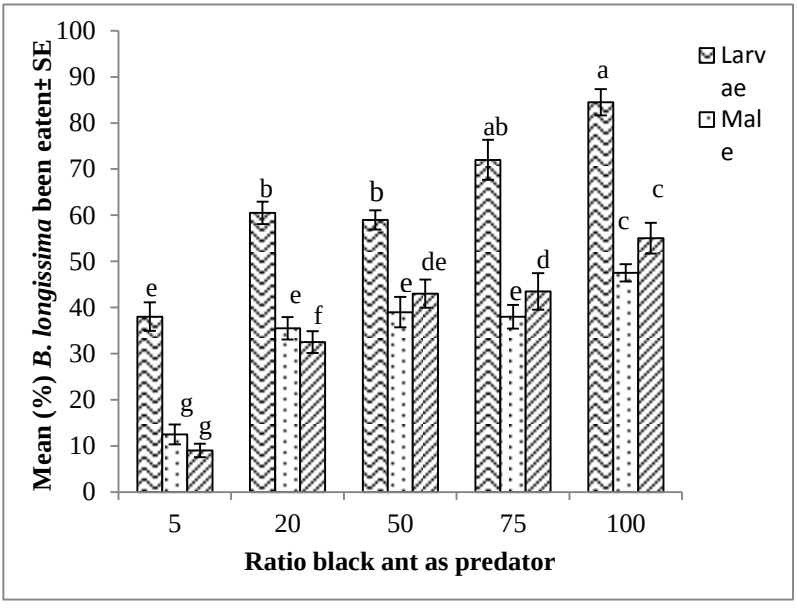

Figure 3. Mean percentage of larvae and adult male and female *B. longissima* were consumed by black ants on different groups of predators

The tendency of black ants to choose different life stages *of B. longissima* as food

One-way ANOVA test results found that there were significant differences ($F = 59.13$, $df = 3,39$; $P < 0.05$) are shown on the mean percentage (%) life stages of *B. longissima* beetles that are eaten by black ants, *Dolichoderus sp*. *B. longissima* larvae had consumed the highest mean percentage (84.5 ± 3.11) % and significantly different ($P < 0.05$) compared to the other stage.

The pupae stage of *B. longissima* has the lowest mean percentage consumed by the black ants (30.5 ± 2.03) % and significantly different (P <0.05) than others. Interestingly, there is not much difference between the mean percentage of adult male *B. longissima* eaten by the black ants which is (54.0 ± 2.33) % and the mean percentage of adult females of *B. longissima* (53.5 ± 3.73) % (Figure 4).

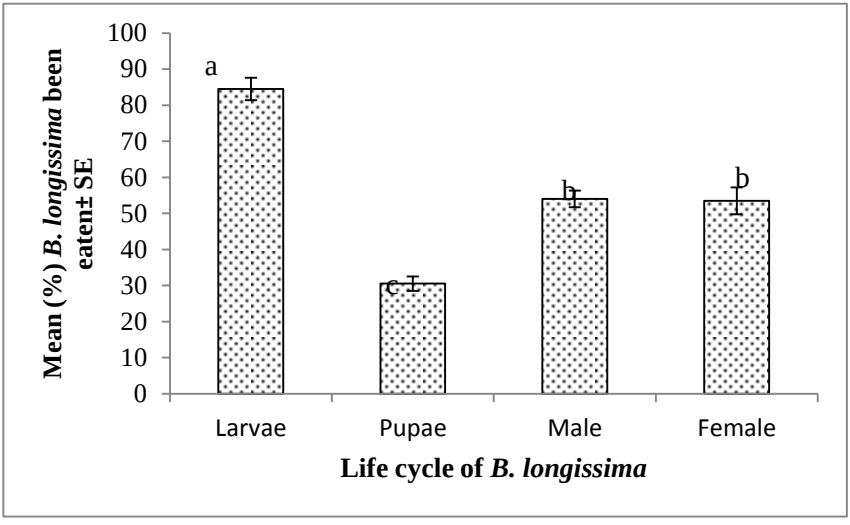

Figure 4. The mean percentage of *B. longissima* were consumed by black ants

The study was conducted to see the trend of predatory black ants *Dolichoderus sp.* on *B. longissima* when all stages of the beetle is given in the same container. The results showed that the predatory ants tend to eat the beetle larvae by the total percentage are eaten is higher and varies significantly (P <0.05) compared to other levels (Figure 4). The trend of black ants beetle larvae attack is possible because the nutrient content of protein in the larval stage is more than pupa and adult. According to Rahayu (2007), ants need protein as an energy

source to carry out the activities of life. In addition, the body larvae surface is softer than the pupa and adult beetles have a tougher skin is a mybe is a factors that affect the predatory black ants against beetle larvae. According to Slansky Jr. And Rodriguez (1987), in such form, size and texture, taste and smell of the victims is a major component of prey selection. A result of this study was similar to previous studies on predatory black ants *Dolichoderus sp*. where most predators tend to choose the larval stage of the insect pests than others (Way and Khoo 1992; Ansaari 2004; Dona et al. 2014).

CONCLUSION

Results from this study indicate predatory black ants, *Dolichoderus sp*. have the potential to be used as biological control agents on pest *B. longissima.* This can be seen when all stage of *B. longissima* able to eat and attack by predators. The findings also supported a study done by Dona et al. (2014) found the black ants *Dolichoderus sp*. attack the larvae and adult *B. longissima.* According to Saripah and Azhar (2003), although black ant not aggressive ants, but it will strike if it's environment is disrupted by the presence of other insects. This was evident when the presence of a predator population of black ants in the cultivation of cocoa and coconut integration has been able to reduce the level of cocoa borer pest attacks, *Helopeltis* on cocoa fruits (Azhar 1985; Khoo and Ho 1992). While Azhar and Moses (1988) found that most black ants *Dolichoderus sp.* build their nests on the tops of coconut unopened or 'crown' as it provides a source of food and shelter, which consists of debris to a black ants. The situation is more favorable to the black ants to attack *B. longissima* beetles are often found taking the helm and folding thatch (Wan Khairul et.al 2014) as well as visits to control this pest insect populations in the area of cultivation of coconut trees.

Overall, the predators, black ants *Dolichoderus sp.* able to kill all stages *B. longissima.* This coincided with Hagen et al. (1999) which states that insect predators capable of consuming various levels of prey, whether the eggs, larvae or adult continuously throughout the life cycle of a predator. While the research Edy et al. (2008) the predator *D. thoracicus* ants also found is capable of consuming different levels of cocoa pests *C. cramerella*. In addition, the bites of black ant do not cause serious injury to a human compare an ant ants makes this predator suitable to breed in coconut plantation area (Saripah & Azhar 2003). Even so, efforts must be undertaken to maintain the population of black ants *Dolichoderus sp*. at a sufficient level in coconut plantation area to ensure the success rate to control *B. longissima* using blanck ant as a predator. There are many factors that influence the population of black ant such as a good farm management practices, practices of pesticides uses, and condition and total of tree canopy (Saripah & Azhar 2003). Beside that, the presences of mealybug on coconut trees will increase a population of black ant. Its based on the finding several study that show a coloration between mealybug and black ant which mealybug acts as a supplier of honey as a food source for black ants (Ang 1988; Ho & Khoo 1997; Azhar et al. 2000).

ACKNOWLEDGEMENT

Many thanks go to Mr. Azman, En. Ruslan, En. Mazlan and En. Rahim who have helped during this research is carried out mainly in the control of field work. Special thanks also to the Director of the Systematic Insects, Universiti Kebangsaan Malaysia, Director of the Research Center of Plant & Soil Science, MARDI and Chief of Station, Department of Agriculture Parit Botak, Johor had given permission to do the work in the laboratory of Entomology, netting house and plot of coconut. Their kindness will not be forgotten.

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