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EVALUATION OF INFESTATION IN PARASITOIDS ON *Metisa plana* Walker (LEPIDOPTERA: PSYCHIDAE) IN THREE OIL PALM PLANTATIONS IN PENINSULAR MALAYSIA

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ABSTRACT

The bagworm, *Metisa plana* Walker (Lepidoptera: Psychidae) is one of the most dominant pest species on oil palm plantations in Malaysia which can cause high yield loses up to 43% over two years after a serious infestation. Parasitoids play an important role as natural enemies to reduce bagworm's population. The interaction of this pest and parasitoids are highly influenced by the availability of bagworms as a host. Highly infested oil palm plantation in Banting, Selangor, Tapah, Perak and Yong Peng, Johor were chosen as sampling sites. This study represented parasitoids species that associated with *Metisa plana* namely *Cotesia metesae* (51%: 70 individuals), *Brachymeria carinata*

(21%: 28 individuals), *Buysmania oxymora* (13%: 18 individuals), *Goryphus bunoh* (8%: 11 individuals), *Pediobius* sp. (5%: 7 individuals) and *Eupelmus cotoxanthae* (2%: 3 individuals) in highly infested oil palm plantation in Peninsular Malaysia. It is known that parasitoid species *Cotesia metesae* recorded the highest number of emergence among all parasitoids and presence in all sampling sites. The information regarding parasitoids species in oil palm plantation is crucial in order to regulate the bagworms population.

Keywords: infestation, parasitoids, *Metisa plana*, oil palm.

ABSTRAK

Ulat bungkus, *Metisa plana* Walker (Lepidoptera: Psychidae) merupakan spesies yang paling dominan bagi ladang kelapa sawit di Malaysia yang menyebabkan kehilangan hasil sehingga 43% selepas dua tahun mengalami infestasi yang serius. Parasitoid memainkan peranan yang sangat penting sebagai musuh semulajadi dalam mengurangkan populasi ulat bungkus. Interaksi antara perosak ini dan parasitoid amat dipengaruhi oleh kehadiran ulat bungkus sebagai perumah. Ladang kelapa sawit yang mengalami infestasi yang serius di Banting, Selangor, Tapah, Perak dan Yong Peng, Johor telah dipilih sebagai kawasan kajian. Kajian ini mendapati spesies parasitoid yang berasosiasi dengan *Metisa plana* termasuklah *Cotesia metesae* (51%: 70 individu), *Brachymeria carinata* (21%: 28 individu), *Buysmania oxymora* (13%: 18 individu), *Goryphus bunoh* (8%: 11 individu), *Pediobius* sp. (5%: 7 individu) dan *Eupelmus cotoxanthae* (2%: 3 individu) di ladang kelapa sawit yang mengalami infestasi ulat bungkus yang serius di semenanjung Malaysia. Ini dapat dibuktikan bahawa parasitoid spesies *Cotesia metesae* mencatatkan kehadiran yang paling tinggi berbanding parasitoid yang lain bagi semua kawasan kajian. Maklumat berkenaan

spesies parasitoid yang diperolehi di ladang kelapa sawit amat penting dalam mengawal populasi ulat bungkus.

Kata kunci: infestasi, parasitoid, *Metisa plana*, kelapa sawit.

INTRODUCTION

The three major bagworm species which are pests of oil palm in Malaysia are *Metisa plana* Walker, *Pteroma pendula* Joannis and *Mahasena corbetti* Tams. In Peninsular Malaysia, *Metisa plana* is the most serious and dominant pest of oil palm (Norman et al. 1994; Norman & Basri 2007) while *Pteroma pendula* is the second most economical important bagworm (Basri et al. 1988) and for *Mahasena corbetti*, this species is rarely reported as serious pest in Peninsular Malaysia, but it is being known as major defoliator and widely distributed in Eastern Sabah (Wood & Nesbit 1969; Young 1971). *Metisa plana* is capable of being present as outbreak and a damage of 50% which would cause high yield losses up to 40 to 47% over two years after a serious infestation (Teo 2003). Regarding Craven (2011), the palm oil industry in Malaysia continues to dominate the global supply of the world's palm oil which also covered almost 73% of the total agriculture land (Ng et al. 2012). The continuity of bagworm's outbreak in Malaysia may contribute to the severe economic problem if not taken seriously.

According to Chong et al. (1991), several methods can be used to control *M. plana* in most oil palm plantation managements by spraying chemical insecticides such as trichlorfon for younger oil palm and using acephate through trunk injection for the older oil palm. Some of the previous studies on the application of chemical pesticide has been conducted (Rhainds et al. 2009) and also using pheromone mass trapping to reduce the reproductive behavior of the *M. plana* by decrease damage and increase the yield of oil palm (Norman et al. 2010).

Biological control using natural enemies has always been regarded as the use of organisms including parasitoids, predators and pathogens for the control of pest population and are environmentally friendly compared to the chemical insecticide. Hu & Vinson (1998) stated that by using biological control agents to control *M. plana* has become increasingly an important pest management strategy because of an increasing concern on the overuse of chemical pesticide.

Parasitoids are one of the important group of natural enemies that survive on the nectar of beneficial plants as a source of food (Norman & Mohd Basri 2010), while their life cycles are dependent on their preferred hosts (Nor Ahya et al. 2012). Based on Kamarudin & Arshad et.al (2016), there were seven families of hymenopterous parasitoids of bagworms namely Ichneumonidae, Eulophidae, Chalcididae, Braconidae, Eurytomidae, Eupelmidae and Ceraphronidae within an oil palm plantation in Perak, Malaysia. They are typically parasitoids of other insects, parasitizing and ultimately killing their hosts and the most common hosts are the larvae of Lepidoptera, Coleoptera, and Diptera (Wharton et al. 1997). The interaction between bagworm and parasitoid are highly influenced by the presence of beneficial plants surrounding the plantation areas (Norman & Mohd Basri 2010), and the availability of bagworms as host (Cheong et al. 2010).

In oil palm plantation, *Apanteles metesae* seems to be the most prominent primary parasitoid of *M. plana* (Basri et al. 1995) and it attacks the host from the second to the sixth instars, that are the most destructive stages to oil palm (Gauld & Bolton 1988). In such situation, the need for utilizing natural enemies for the biological control of the insect pest appears important. In order to develop a viable biological control strategy, it is essential to catalog the various natural enemies of insects infesting oil palm.

Thus, this study aims to evaluate the infestation in parasitoids on *Metisa plana* in three oil palm plantations in Peninsular Malaysia.

MATERIALS AND METHODS

Sample Collection

This research was conducted in September 2016 until June 2017. The sampling sites were selected according to the highly infested area with *Metisa plana* in Peninsular Malaysia such as in Sime Darby Plantation in Banting, Selangor, Tapah, Perak and Yong Peng, Johor as the infestation of *M. plana* majorly in the west part of Peninsular Malaysia (Ho et al. 2011).

The individuals of bagworms collected twice at each sampling sites were reared alive together with the fronds of oil palm trees in containers (27 cm x 13.5 cm) covered with muslin cloth for the emergence of parasitoids. Once emerged, these parasitoids were collected and preserved in 70% alcohol to be identified. The convenient environment for the rearing of bagworms and the emergence of its parasitoids was 70% to 75% for humidity and 24°C for temperature.

Species Identification

The identification of parasitoids species was done by referred to Handbook of Common Parasitoids and Predators Associated with Bagworms and Nettle Caterpillars in Oil Palm Plantations (MPOB) (Norman et al. 1998) and Kamarudin et al. (1996).

Analysis of Data

In order to determine the present/absent of parasitoids species in each sampling sites, the two-way cluster analysis or dendogram were constructed by using PC-ORD 6 (MjM Software 2001).

RESULTS

A total of 137 individuals of parasitoids that mainly associated with *Metisa plana* were belonging to five families namely Braconidae, Chalcididae, Ichneumonidae, Eupelmidae and Eulophidae. The parasitoids species that associated with *Metisa plana* represented by *Cotesia metesae*, *Brachymeria carinata, Goryphus bunoh, Buysmania oxymora, Eupelmus cotoxanthae* and *Pediobius* sp. (Figure 1).

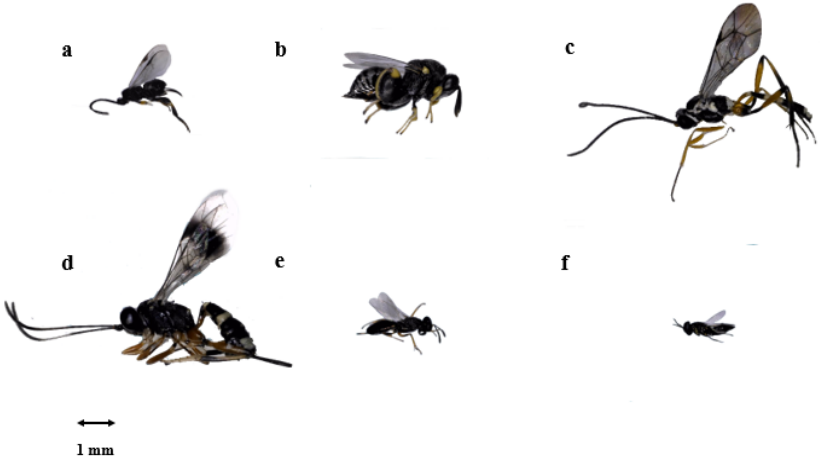

Figure 1. Parasitoids species a) *Cotesia metesae,* b) *Brachymeria carinata,* c) *Goryphus bunoh,* d) *Buysmania oxymora,* e) *Eupelmus cotoxanthae* and f) *Pediobius* sp.

The species composition of parasitoids in Figure 2 showed that *Cotesia metesae* (family: Braconidae) scored the highest percentage of emergence with 51% with 70 individuals. *Brachymeria carinata* which belongs to family Chalcididae scored 21% with 28 individuals followed by *Buysmania oxymora* (family: Ichneumonidae) (13%: 18 individuals), *Goryphus bunoh*

(family: Ichneumonidae) (8%: 11 individuals), *Pediobius* sp. (family: Eulophidae) (5%: 7 individuals) and lastly *Eupelmus cotoxanthae* (family: Eupelmidae) (2%: 3 individuals).

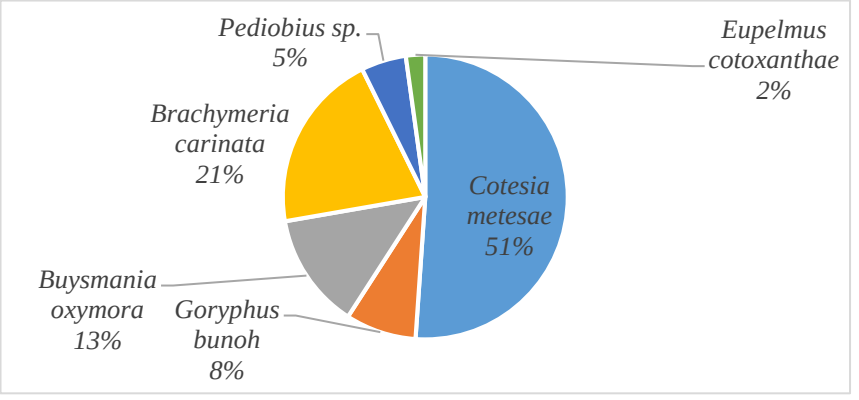

Figure 2. Species composition of six parasitoids species collected from sampling sites

Based on the dendogram (Figure 3), Tapah, Perak showed the highest number of emergence of parasitoids species (six species) followed by Yong Peng in Johor (four species) while Banting, Selangor only presented two species of parasitoids (*Cotesia metesae* and *Goryphus bunoh*). Parasitoids species *Pediobius* sp. and *Eupelmus cotoxanthae* only emerged in Tapah, Perak but relatively with a low number of individuals. The presence of *Buysmania oxymora* and *Brachymeria carinata* only noticed in Tapah, Perak and Yong Peng, Johor but not in Banting, Selangor while *Goryphus bunoh* only absent in Yong Peng, Johor. In this study, it is clearly showed that *Cotesia metesae* scored the highest number of individuals emerged and presence in all sampling sites.

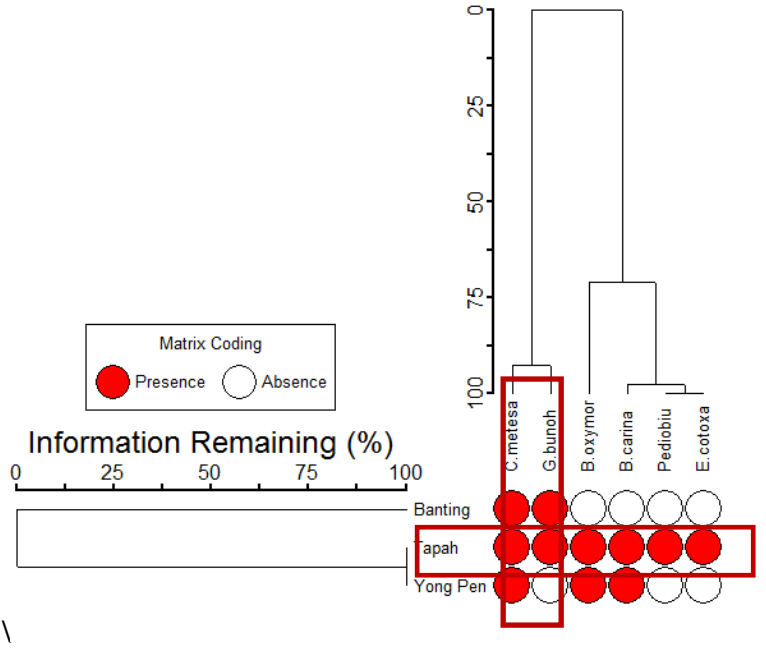

Figure 3. Two-way cluster analysis (dendogram) based on the parasitoid species present/absent in each sampling sites

DISCUSSIONS

Parasitoids are well suitable to monitor landscape changes because of their abundance, species richness and most of them are universal in occurrence Lewis & Whitfield (1999). Moreover, the parasitoid communities also are very crucial in population regulation of other insect herbivores that indirectly or directly commit in maintaining the stability of any ecosystem (Jervis & Kidd 1993). Kulman (1965) studied the natural control factors operative in the population of the bagworm and concluded that insect parasites and predators can reduce the bagworm population by 25%. Parasitoid community also being known as one of the

mortality factors that affecting the population of bagworms approximately 36.7% in Perak, Malaysia (Cheong et al. 2010).

According to Ali et al. (2007), the abundance and diversity of the parasitoids were affected by the presence of beneficial plants such as *Cassia cobanensis*, *Euphorbia heterophylla* and *Antigonon leptosus*. This is also supported by the study from Nitschke et al. (2016) which claimed that the plant diversity has positive effects on parasitoids abundance *Centaurea jacea* flower heads in Germany. Norman & Mohd Basri (2010) strongly suggested the importance of establishing beneficial plants within the surroundings of oil palm plantation in order to sustain the population of natural enemies for long-term control of bagworms. However, the sampling sites in this study exhibit such a low presence of beneficial plants around the oil palm plantations due to lack of information about the importance of this plants towards the abundance of parasitoids among smallholder farmers.

Cotesia metesae constituted the most abundance species of parasitoids that emerged in all sampling sites which showed that this parasitoid is dominant species associated with *Metisa plana.* Referring to Hanysyam et al. (2013) study, *C. metesae* also scored the highest percentage among all parasitoids species in Felda Gunung Besout 6 Sungkai, Perak. This parasitod species noticed as primary parasitoid for bagworm species *Metisa plana* and *Pteroma pendula* but its parasitizing activities can be interrupted by *Pediobius imbrues*, which acted as hyperparasitoid (Cheong et al. 2010). Based on this study, both *C. metesae* and *Pediobius* sp. emerged together in Tapah, Perak and it is clearly showed that the activity of *D. metesae* as primary parasitoid does not interrupted as it emerged more than *Pediobius* sp. In addition, Salmah et al. (2006) stated that the highest number of bagworm larvae parasitized by *C. metesae* was at fourth and fifth instars

which support this study as the collection of *Metisa plana* involved the fifth instar and above.

Brachymeria carinata acted as primary parasitoid for both bagworm species *Metisa plana* and *Pteroma pendula*. This parasitoids species has slightly different morphological characteristics compared to other parasitoids which is the large and swollen femur (Norman et al. 1998). *B. carinata* was recorded as one of the hymenopterous parasitoids associated with *Metisa plana* and *Pteroma pendula* in Peninsular Malaysia (Kamarudin et al. 1996) while this species appeared to be no record in Felda Gunung Besout 6 in 2013.

Goryphus bunoh and *Buysmania oxymora* resemble almost similar morphological characteristics but *B. oxymora* is larger and has pale segments in the middle of the antennae. Based on Norman et al. (1998), *B. oxymora* only found on *Darna trima* as a primary parasitoid and may also affected other nettle caterpillar such as *Setora nitens* and *Darna diducta* while in Felda Gunung Besout 6, this species contribute only 1% presence among all parasitoids species (Hanysyam et al. 2013). However, this study showed that *B. oxymora* presented higher abundance compared to *Goryphus bunoh* which was found as a primary parasitoid for both *Metisa plana* and *Mahasena corbetti* but can be a hyperparasitoid for nettle caterpillar species, *Setora nitens* (Lepidoptera: Cochlidiidae) (Norman et al. 1998).

As for *Eupelmus catoxanthae*, only three individuals collected from Tapah, Perak. This species can be found on *Metisa plana* and *Mahasena corbetti* as both primary and hyperparasitoid. *E. catoxanthae* also attacked moth pest species *Artona catoxantha* and *Parasa lepida* (Kamarudin et al. 1996).

CONCLUSION

In this study, there were more than one species of parasitoids emerged in one locality but constituted with different abundances. The host size and age also were believed to influence the host choice and acceptance by parasitoid (Vinson 1976). Apart from that, a study from Briggs (1993) proved that it is highly possible that competition among parasitoids species occurred on the same host which will affect on host suppression. It is proven that parasitoid community enrolled as successful natural enemies to bagworms species especially *Metisa plana* in oil palm plantation in Peninsular Malaysia.

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CONFLICT OF INTERESTS

The authors declare that no competing financial interests exist.

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