Abundant parasitoids of *Erionota thrax* (Lepidoptera; Hesperidae) in four banana plantations around Bandung areas.

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Abstract

Banana skipper *Erionota thrax* (Lepidoptera; Hesperidae), known as banana leaf roller, in some cases can cause complete defoliation of banana plant. Therefore, this species is considered as a main pest for banana plant both in its native (Southeast Asia) and non-native areas. There are several parasitoid species known to attack *E. thrax* in each of its development stage, i.e. eggs, larvae and pupae. In both dry and rainy seasons, *E.thrax* parasitoid from four banana plantations around Bandung areas, i.e. Subang, Lembang, Dago, and Soreang were monitored by field and laboratory observations. The results showed that, eight primary parasitoid were recorded: *Ooencyrtus erionotae* (Hymenoptera: Encyrtidae), *Pediobius erionotae* (Hymenoptera: Eulophidae), *Agiommatus sumatraensis (*Hymenoptera: Pteromalidae*)*, and Palexorista *solensis* (Diptera: Tachinidae), *Charops sp*.(Hymenoptera: Ichneumonidae), *Cotesia (Apanteles) erionotae (*Hymenoptera: Braconidae), and *Xanthopimpla gampsura (*Hymenoptera: Ichneumonidae), *Brachymeria thracis* (Hymenoptera: Chalcididae) were, respectively, the major egg, larval and pupal parasitoids. *P. erionotae* were the highest found in all stages, ie. eggs, larvae and pupae, followed by *Brachymeria sp.*

Interestingly, for some reasons, the population of parasitoid during both rainy and dry season was about the same. We reasoned that the presence of the eight parasitoids (seven Hymenopterans and one Dipteran) all year long was due to the availability of eggs, larvae and pupae of *E. tharx* as well as plant diversity around the banana plantation in question, at which provide parasitoids with resources such as favorable microclimate, alternative hosts, as well as pollen, nectar or honeydew for adult parasitoids. In general, the abundance of parasitoids showed a similar tendency to that of the *E. thrax,* with level of parasitism never exceeding 50 %. Therefore, in this case, if one wants to use these parasitoids as biological control agents to control *E. thrax*, some strategies need to be developed, for instance by augmentation (reared in large numbers and periodically released to suppress the pest population).

Keywords: *Erionota thrax*, parasitoids, banana plant.

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Introduction

The banana skipper, *Erionota thrax* (Lepidoptera: Hesperiidae) is native to South-Asia region. From SEA the skipper spread to many parts of the tropical world and was found in Guam in 1956, Mauritius in 1970, Hawaii in 1973 and Papua New Guinea in 1983 (Sands et al. 1991, Sand et al. 1993). *E. thrax* which is also known as banana leaf roller, is a dangerous pest for bananas, in some cases where it can cause complete defoliation of banana plants, leaving plants with only their leaf veins. Therefore, this species is considered as a main pest for banana plants both in its native (Southeast Asia) and non-native areas. In Indonesia, *E. thrax* is a serious pest of banana plantation, where it was reported that in the year 1982 and 1983 this pest has caused significant damage to banana plantations in several parts of Java Island.

The dynamic population of *E. thrax* as other herbivorous insects is regulated by various dependent and independent factors. One of the important dependent factors is the pressure from natural enemies (Hunter and Price, 1992). These natural enemies, including parasitoids are responsible for limiting the population of herbivorous insects not only in natural ecosystem but also in agro ecosystem.

Even tough *E. thrax* occasionally could inflict serious damage to banana plantation, in its native area, including Indonesia; it is not always considered to be of much economic significance. This is believed because it is widely attacked by its natural enemies, i.e. parasitoids in the egg, larval and pupal stages. However, it is unfortunate to note that data about *E. thrax* and its parasitoid in Indonesia has not been widely known since the interest to collect data about *E. thrax* parasitoid has only begun in 1990 (Erniwati, 1994). The survey conducted by Erniwati (1994) in several localities in West Java found three species of egg parastoids, i.e. *Pediobius erionotae* (Eulophidae), *Agiommatus sumatraensis* (Pteromalidae), *Ooencyrtus erionotae* (Encyrtidae); six species of larval parasitoids, i.e., *Elasmus sp* (Eulophidae), *Symiensi sp* (Eulophidae), *Apanteles erionotae* (Braconidae), *Casinaria sp* (Ichneumonidae), *Tachinid sp* (Tachinidae), *Eurytoma sp* (Eurytomidae) ; and four pupal parasitoids, i.e., *Xanthopimpla gampsura* (Ichneumonidae), *Brachymeria lasus* (Chalcididae), *B. Thrachis* (Chalcididae) and *Theronia zebra zebra* (Ichneumonidae).

Given the very limited information about the natural enemies of *E. thrax* in Indonesia, particularly its parasitoid, the objectives of this study was to find out the availability of parasitoids of E. thrax during rainy and dry season in four different places (with different altitude above sea levels) around Bandung and to find new candidate(s) to act as a biological control agent. In addition, since plant diversity is known to have positive correlation with the availability of parasitoids, the diversity index based on Shannon Index was also carried out.

Material and Methods

Four agro ecosystem sites with different altitudes were chosen, i.e. Banana plantations in Subang [50 m above sea level (a.s.l)], Lembang (1200 m a.s.l), Dago (900 m a.s.l) and Soreang (400 m a.s.l). All stadia of *E. thrax* found (eggs, larvae and pupae) in banana plantations were collected and brought and reared in the laboratory. Parasitoids emerging from each stadia of E. thrax were collected and determined. The parasitoids were recorded to establish the percentage of parasitism. Their relative abundance of the different parasitism was also established. Various plants around the research areas were also identified and noted, and the diversity index was calculated by Shannon Index (Odum 1971). Parasitoid abundance was also measured during the dry and rainy seasons of January 1997-March 2000.

Results and discussion

The study showed that the Banana Skipper *E. thrax* is attacked by a relatively wide range of parasitoids as shown below. Percentage parasitism at the four sites was never exceeding 50 %, so it is considered not enough for the parasitoids to act as a good biological control agent.
The results showed that 8 (eight) E. thrax were recorded as follows:

1. *Ooencyrtus erionotae* (Hymenoptera: Encyrtidae)
2. *Pediobius erionotae* (Hymenoptera: Eulophidae),
3. *Agiommatus sumatraensis (*Hymenoptera: Pteromalidae*)*,
4. *Charops sp*.(Hymenoptera: Ichneumonidae),
5. *Cotesia (Apanteles) erionotae (*Hymenoptera: Braconidae),
6. *Xanthopimpla gampsura (*Hymenoptera: Ichneumonidae),
7. *Brachymeria thracis* (Hymenoptera: Chalcididae)
8. *Palexorista solensis* (Diptera: Tachinidae)

The above parasitoids found in this experiment are considered low as compared to the findings by Erniwati (1994) conducted in several West Java areas. At that time she was able to collect 3 species of eggs parasitoid, 6 species of larval parasitoids and 4 pupal parasitoids, totaling 13 species of parasitoid. There is one possible explanation to this discrepancy, that morphological and physiological variations occur during the development and maturation of banana plants as well as the diversity of plants around the banana plantations under study.

Comparing the most abundant and dominant parasitoids during dry and rainy seasons shows that (Table 1) *Pediobius erionata* was the most abundant parasitoid species, *Brachymeria thracis* had

moderate occurrence, while *Agiomatus sumatraensis* and *Ooencyrtus erionotae* were the least abundant and only found during the dry season. The fact that *P. erionata* is the most abundant is interesting because in other parts of the world, i.e. in Malaysia and Thailand the most abundant is *Ooencyrtus erionotae* (Waterhouse 1991). A possible explanation for this may be that Pediobius erionata has a higher population build-up in the environment than the other natural enemies because it can parasitize egg, larva and pupa as well. Even though this explanation is not sufficient to explain why that is not the case in Malaysia and Thailand (the most abundant is *O. Erionotae*). It is also interesting to note that *Agiommatus sumatraensis* (egg and larval parasitoid) and *Ooencyrtus erionotae* were only found during the dry season. It is not clear why we found this phenomenon, therefore more field studies relating to *E. thrax* and its parasitoid seasonality are necessary to be conducted to understand more about the interaction between *E. thrax* and its parasitoids.

Table 1. The most abundant and dominant parasitoids during dry and rainy seasons

Localities	**Dry Season**	**Rainy season**
Subang (50 m a.s.l.)	*Agiommatus sumatraensis (E and L)*	***Pediobius erionotae*** *(E, L, and P)*
Soreang (400 m a.s.l.)	***Pediobius erionotae*** *(E, L and P),* ***Brachymeria thracis*** *(P), and Ooencyrtus erionotae (E)*	***Pediobius erionotae*** *(E, L, and P) and* ***Brachymeria thracis*** *(P)*
Dago (900 m a.s.l.)	***Brachymeria thracis*** *(P) and Ooencyrtus erionotae (E)*	***Pediobius erionotae*** *(E, L, and P) and* ***Brachymeria thracis*** *(P)*
Lembang (1200 m a.s.l)	***Pediobius erionotae*** *(E,L and P) and* ***Brachymeria thracis*** *(P)*	***Pediobius erionotae*** *(E, L, and P) and* ***Brachymeria thracis***

The parasitoid attacking *E. thrax* during dry and rainy season is shown in Table 2. In general the average number of eggs parasitoid was higher during the rainy season (347.7 vs. 277.7), but interestingly the number of larval parasitoid was higher during the dry season (361.3 vs. 271.2) and number of pupal parasitoids was about the same during dry and rainy seasons. This variation in number during both seasons suggests that these natural enemies are important factors in the dynamics of *E. thrax* populations.

Table 2. Average number of parasitoid during dry and rainy seasons.

Localities	**Eggs**		**Larvae**		**Pupae**	
	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season
Subang (50 m a.s.l.)	28.0	**47.0**	44.2	34.0	44.0	47.0
Soreang (400 m a.s.l.)	93.5	86.7	138.7	83.0	123.5	102.2
Dago (900 m a.s.l.)	73.2	103.5	82.7	62.7	105.5	93.5
Lembang (1200 m a.s.l)	83.0	110.5	95.7	91.5	123.2	144.7
Total	277.7	347.7	361.3	271.2	396.2	387.4

The plant and egg parasitoids diversity index has a significant relationship. Higher plant diversity caused higher egg parasitoids diversity. It is thought that the egg parasitoid population growth is strongly influenced by the plant diversity found in the surrounding banana plantation, since it was shown that low plant diversity caused lower parasitoid diversity. We also found that increasing plant diversity is followed by increasing of larval parasitoid diversity. We reasoned that the increasing plant diversity would subsequently provide food sources for adult parasitoids, thus increasing their fitness. However, the situation was a bit different with the pupal parasitoid diversity, even though there is tendency that pupal diversity follows the plant diversity.

In conclusion, the findings show that *Erionota thrax* is attacked by seven parasitic wasps and one parasitic Diptera. But the level of parasitism never exceeds 50 %. However, this level still causes high defoliation of banana leaves. Therefore to increase the effectiveness of these biological control agents, some efforts to increase the population is necessary, including ways to preserve their natural habitats. The fact that that the existing natural enemies (native) do not seem to really control the host (*Erionata thrax*), probably because the (apparent) long evolutionary association between the two is an intriguing questions that remains, do we need to import natural enemies that have no known evolutionary history with the pest? This is theoretically possible since a long evolutionary association between the two reduces the effectiveness of natural enemies. Because it is thought that hosts are at a selective advantage in the enemy-host interaction (Price 1977).

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