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INTERACTIONS OF THE BAGWORM, *Pteroma pendula* (Lepidoptera: Psychidae), AND ITS NATURAL ENEMIES IN AN OIL PALM PLANTATION IN PERAK

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ABSTRACT

Bagworms are one of the important leaf-eating pests of oil palm in Malaysia and Indonesia, causing high yield losses up to 43% over two years after a serious infestation. Parasitoids and predators play an important role in regulating bagworm numbers. The propagation and establishment of the natural enemies depend on some suitable species of flowering plants as sources of nectar. Cassia cobanensis, *a leguminous nectar producing plant is recommended to be grown in oil palm plantations as a food source for parasitoids related to the bagworm. An observation on the interactions of the bagworm pest and its natural enemies was conducted at an oil palm plantation in Perak, Malaysia. A bagworm* (Pteroma pendula) *infested block, with* C. cobanensis *planted along the roadside, and a control block with no* C. cobanensis *within their vicinity, were chosen for the trial. In late 2006, the population of the bagworms increased to 60 live larvae per frond (LPF) in the control block, while in the* C. cobanensis *block it remained below 30 LPF. A chemical control operation in early 2007 reduced the population of bagworms to negligible levels for about two years. The natural enemies (predators and parasitoids) were monitored using sticky traps and sweep nets in all the plots. Results show that due to the negligible bagworm hosts in the block, activities of the insect parasitoids shifted to the* C. cobanensis *plants planted along the roadsides. In the control block, the natural enemies still dwelt within the ground covers because of the absence of* C. cobanensis *plants in the vicinity. Activities of predators were seen to be more prominent on ferns while parasitoids preferred to dwell on plants with nectar sources (*C. cobanensis *and* Asystasia gangetica*). These observations strongly suggest the importance of establishing* C. cobanensis *within the vicinity of oil palm plantations in order to sustain the population of natural enemies for long-term control of bagworms.*

Keywords: bagworms, *Pteroma pendula*, natural enemies, beneficial plant, *Cassia cobanensis.*

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INTRODUCTION

Bagworms are one of the important leaf-eating pests of oil palm in Malaysia and Indonesia. Crop losses, due to the extent of defoliation by a serious bagworm attack, are inevitable. A moderate defoliation of about 10%-13% may cause a crop loss of about 33%-40% (Basri, 1993). Common bagworms such as *Metisa plana* and *Mahasena corbetti* are prone to attack by various species of hymenopterous parasitoids (Norman *et al.*, 1996). In the field, it was reported that these parasitoids play an important role in regulating bagworm numbers (Basri *et al.*, 1995). The propagation and establishment of the natural enemies depend on some suitable species of flowering plants as sources of nectar. Basri *et al.* (1999) confirmed that flowering plants prolong the life span of the adult parasitoids in the laboratory.

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Four species of plants considered to be beneficial for bagworm control are *Cassia cobanensis*, *Crotalaria usaramoensis*, *Asystasia gangetica* and *Euphorbia heterophylla*. However, *A. gangetica* is a pestiferous weed and is not recommended to be propagated. Ho (2003) has also quantitatively evaluated the effects of several beneficial plants in field caged trials. He confirmed that *C. cobanensis* and *E. heterophylla* are almost equal in terms of attracting parasitoids in the field. However, *C. cobanensis* has the competitive edge in that it is easier to propagate and need not be continually replanted every three months as is the case with *E. heterophylla*.

This study was intended to gather information on the interactions of the bagworm with its natural enemies, and the long-term effects of having beneficial plants in the ecosystem of a commercial oil palm plantation for bagworm control.

MATERIALS AND METHODS

An oil palm plantation infested with the bagworm *Pteroma pendula* was selected in Telok Intan, Perak. Two blocks were selected: one with the beneficial plant, *C. cobanensis* planted along the roadside, while the other block, without *C. cobanensis* within its vicinity, was used as the control. Each block was about 5 ha, with palm age of three to four years at the start of the study. Within each block, three sampling plots were designated, from the outer edge towards the inner part of the block. Each sampling plot consisted of 10 recording palms.

For each block, insect parasitoids and predators were captured by a sweep net, between 9.00 a.m. and 12.00 noon on each designated day every month.

A square trap was made from plywood and painted yellow, with a plastic cover, and sprayed with polybutene gum (Brand: NEOPEACE-F101 - Polybutene - 16% w/w) on both surfaces. The trap was placed approximately 1.5 m above the ground, in the middle of the beneficial plant grove and left in the field for two days. Each trap was replicated three times. Data were collected the following morning (9.00 a.m.), for two consecutive days.

Live bagworms were brought back and reared on oil palm leaflets, or kept in small plastic vials until the emergence of the parasitoids. The parasitoids which emerged or captured in the field were then identified (Norman *et al.*, 1998).

RESULTS AND DISCUSSION

In late 2006 (November), there was no emergence of parasitoids in the control block (without *C. cobanensis* in the vicinity), which in turn might have contributed to the increase in the live larval population of *P. pendula* up to 60 larvae per frond (LPF) (*Figure 1*). This was considered the highest level for live larvae in this block. It was noted that the peak number of live larvae in the *C. cobanensis* block was always below 30 LPF (*Figure 2*). The emergence of parasitoids also appeared to be more consistent in the *C. cobanensis* block (between 5 and 16 individuals) (*Figure 2*) compared to the control block, although in some months, there was higher emergence of parasitoids (20-35 individuals) in the control block (*Figure 1*).

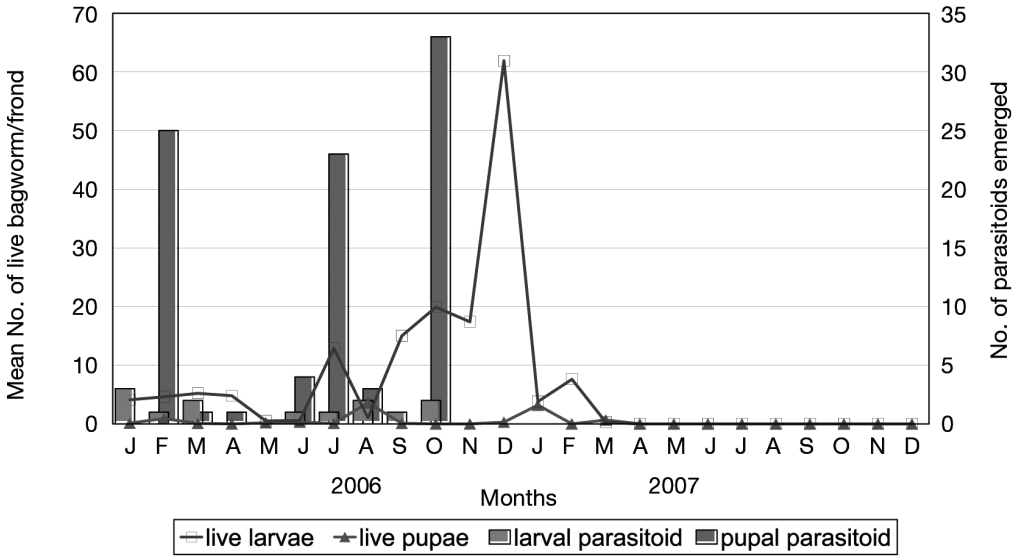

Figure 1. Fluctuations in the number of live P. pendula *in the control block in relation to emergence of parasitoids at a Telok Intan oil palm plantation.*

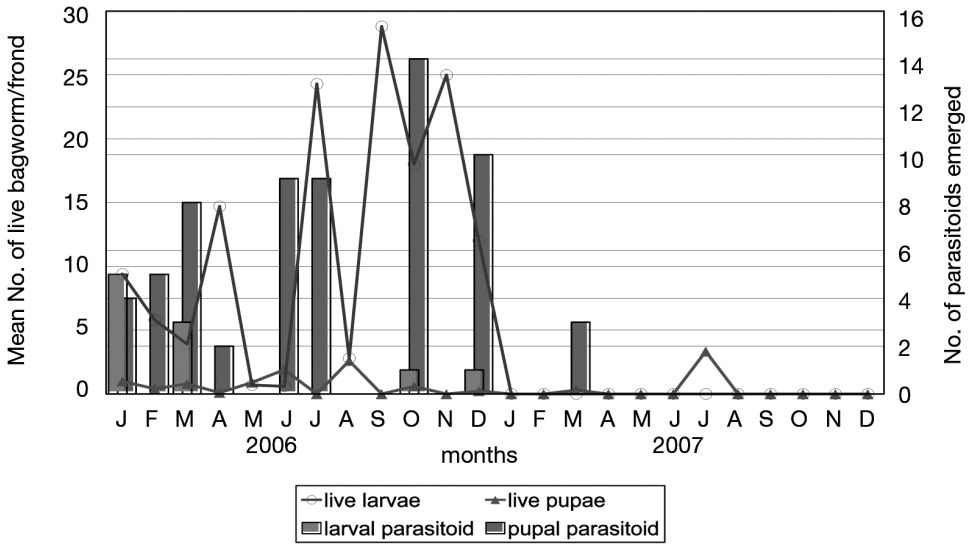

Figure 2. Fluctuations in the number of live P. pendula *in the* C. cobanensis *block in relation to emergence of parasitoids at a Telok Intan oil palm plantation.*

A chemical control operation using trunk injection with methamidophos and spraying with cypermethrin was conducted by the estate management in early (January to February) 2007. Thereafter, the live larval numbers fell below the threshold level of 10 LPF. In March 2007, the numbers were 0.76 and 0.80 for *C. cobanensis* and control block, respectively, and by April, there was virtually no live larvae detected in both blocks (*Figures 1* and *2*). The population of bagworms remained negligible throughout, until the end of 2007.

Some beneficial weeds like *A. gangetica* were shown to attract parasitoids of the bagworm. With quadrat sampling, the density of this weed was found to be higher in the control block (13 plants per quadrat) compared to the *C. cobanensis* block (7 plants per quadrat). Hence, the higher density of this flowering weed should provide more food sources for the parasitoids.

Samplings in 2008 showed virtually no live larvae or pupae on all the fronds sampled. The activity of parasitoids and predators (based on the sticky trap captures) within the *C. cobanensis* plants appeared to be less compared to when there was a live population of the bagworm (*Figure 3*). However, the resident population of the insects within the *C. cobanensis*

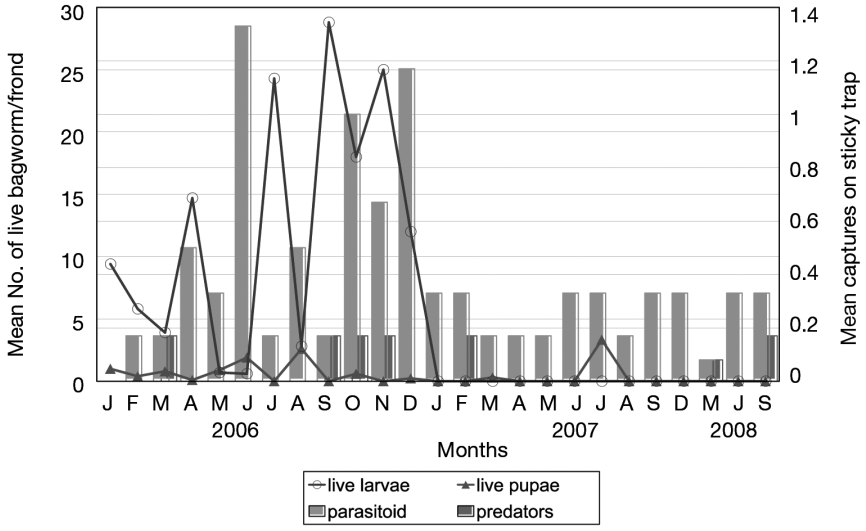

Figure 3. Fluctuations in P. pendula *population in relation to parasitoid and predator activities using sticky traps on the* C. cobanensis *plants (in the* C. cobanensis *block).*

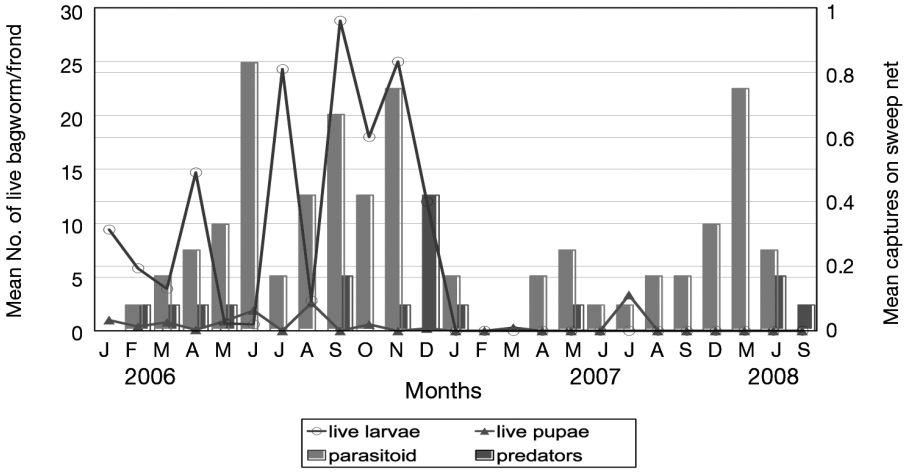

Figure 4. Fluctuations in P. pendula *population in relation to resident parasitoid and predator populations using sweep net on the* C. cobanensis *plants (in the* C. cobanensis *block).*

plants (based on the sweep net captures) seemed to be comparable (*Figure 4*).

Activities of the predators seemed to be more prominent on the ground covers within the *C. cobanensis* block compared to the parasitoids. This suggests that the parasitoids preferred to dwell in the food sources (*C. cobanensis* plants) themselves rather than in the ground covers which consisted mainly of ferns (*Figure 5*). Similarly, the predators were more frequently caught as the resident insect population in the ground covers (*Figure 6*).

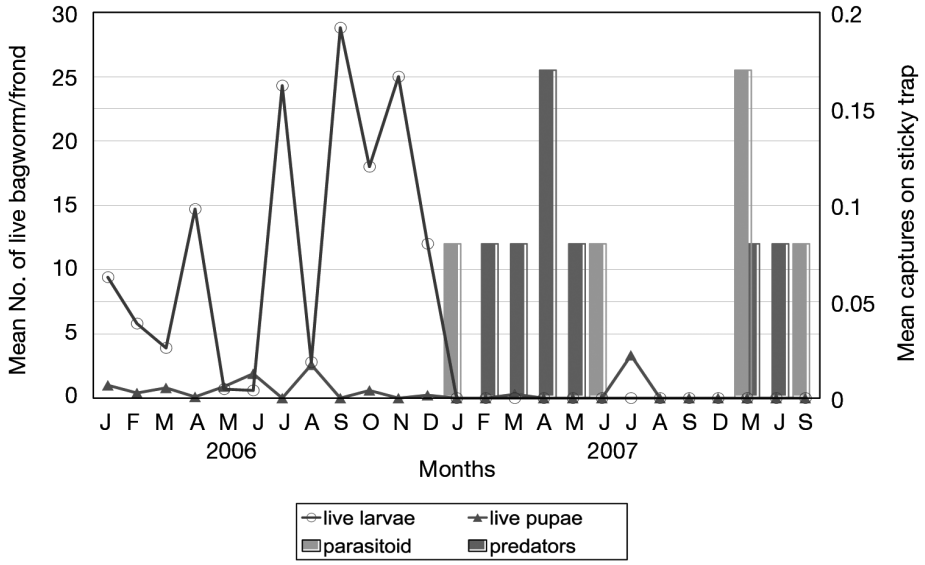

Figure 5. Fluctuations in P. pendula *population in relation to parasitoid and predator activities using sticky traps on the ground covers (of the* C. cobanensis *block).*

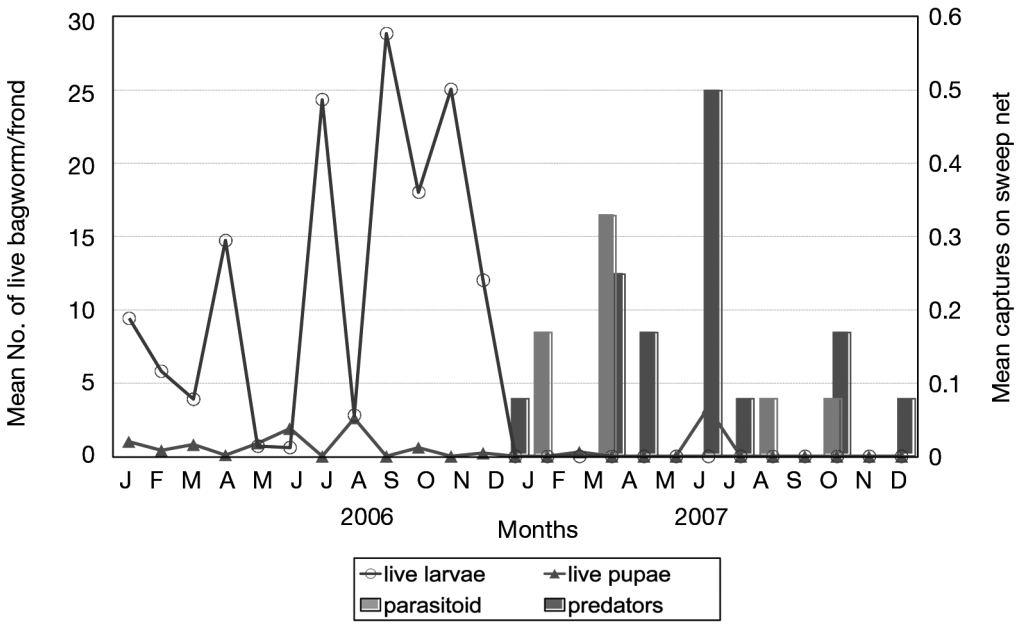

Figure 6. Fluctuations in P. pendula *population in relation to resident parasitoid and predator populations using sweep net on the ground covers (of the* C. cobanensis *block).*

By contrast, within the control block, in the absence of the *C. cobanensis* plants, the parasitoids appeared to be more active in the ground covers than the predators (*Figure 7*). Similarly, as indicated in *Figure 6*, the predators were also frequently caught as residents in the ground covers, but in the

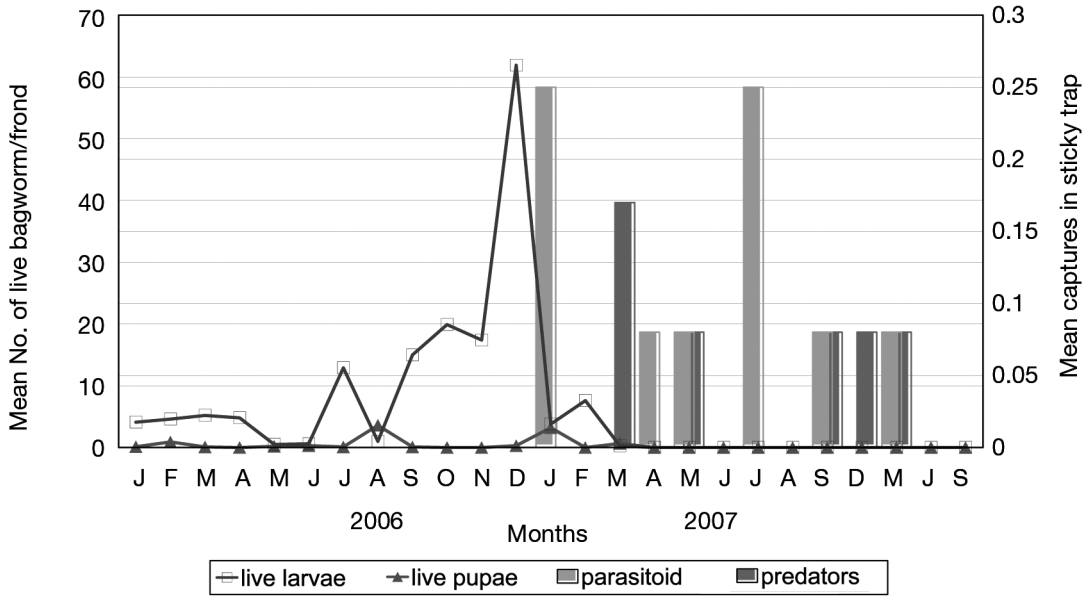

Figure 7. Fluctuations in P. pendula *population in relation to the activities of parasitoids and predators using sticky traps on the ground covers (control block).*

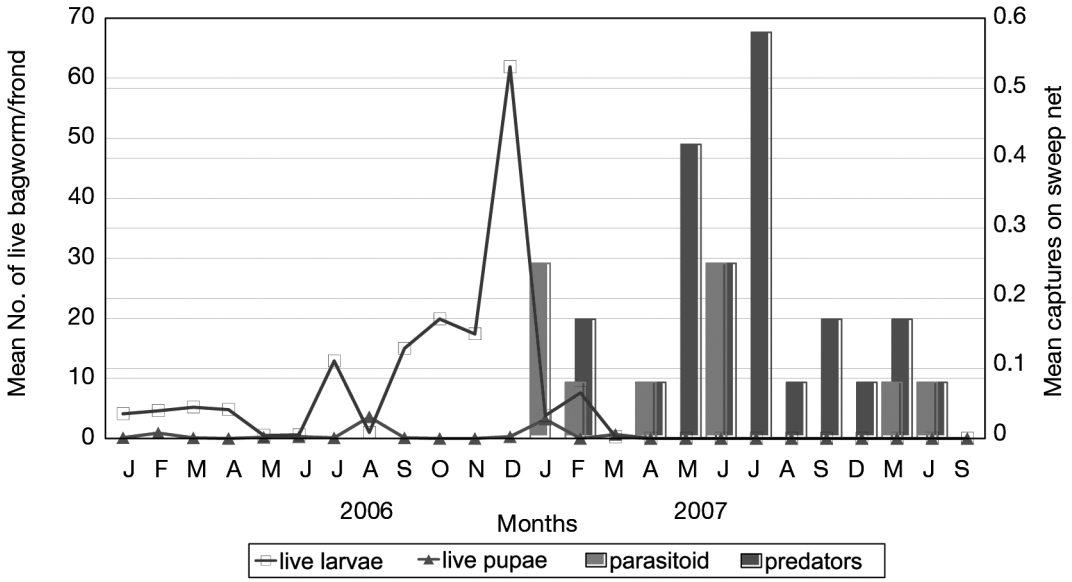

Figure 8. Fluctuations in P. pendula *population in relation to the resident population of parasitoids and predators using a sweep net on the ground covers (control block).*

control block, they were found together with more parasitoids (*Figure 8*). The parasitoids were likely to have been attracted to ground covers such as *A. gangetica*, which also have nectar-producing flowers, as their food sources.

A. gangetica, was commonly found in both the *C. cobanensis* and control blocks. The mean density of this beneficial weed recorded in the *C. cobanensis* plot (4 plants per quadrat) and in the control block (3.7 plants per quadrat) was almost similar. Therefore, the flowering weed in both *C. cobanensis* and control blocks offered food sources for the parasitoids within the respective blocks.

Captures of the natural enemies (individuals per month) were tabulated against the presence and negligible presence of the bagworm host population (*Table 1*). Results indicate that the occurrence of both insect parasitoids and predators was reduced within the *C. cobanensis* block, most likely due to the negligible population of bagworm hosts in the block. Instead, the natural enemies may have shifted to dwell on *C. cobanensis*, as shown by the occurrence of natural enemies having slightly increased on the plants (*Table 1*). In the control block, however, the occurrence of parasitoids and predators increased in

TABLE 1. OCCURRENCE OF BAGWORM NATURAL ENEMIES (parasitoids and predators) IN THE PRESENCE AND NEGLIGIBLE PRESENCE OF THE BAGWORM HOST, *Pteroma pendula*

Location of sampling	**Type of natural enemies captured by sticky traps and sweep nets**	**Numbers of natural enemies captured in relation to bagworm (*Pteroma pendula*) occurrence (individuals/month)**	
		Present (January – March 2007)	**Negligible (April 2007 – September 2008)**
Plot 1 (*Cassia cobanensis* block)	Parasitoids	1.0	1.0
	Predators	1.0	2.0
C. cobanensis plants	Parasitoids	2.3	4.3
	Predators	0.6	0.5
Plot 2 (control plot)	Parasitoids	2.3	1.6
	Predators	1.3	2.4

the ground covers when there were no bagworms (*Table 1*), probably due to the absence of *C. cobanensis* in the vicinity. The negligible occurrence of bagworms on the palm fronds seemed to have forced the parasitoids and predators to dwell more on the beneficial plants and ground covers.

This situation is being monitored further to see whether the population of natural insect enemies slowly diminished or stabilized at low numbers due to the negligible population of the bagworm host. If that happens, there might be a possible resurgence of the bagworm population in the future. Mass rearing of bagworm predators (*i.e. Sycanus dichotomus*), or augmentation of parasitoids for release, may have to be considered to supplement the population of natural enemies in the area.

CONCLUSION

In this study, it was shown that the activities of parasitoids and predators seemed to be dependent to the population of the bagworm host. Due to the negligible numbers of bagworm host in the blocks, activities of insect parasitoids shifted mainly to the *C. cobanensis* plants along the roadsides. In the absence of the beneficial plants, the natural enemies dwelt among the ground covers which also consisted of flowering weeds like *A. gangetica*. Activities of predators were observed to be more prominent on ferns while parasitoids preferred to dwell on plants with nectar sources (*C. cobanensis* and *A. gangetica*). These observations strongly suggest the importance of establishing *C. cobanensis* within the vicinity of oil palm plantations in order to sustain the population of natural enemies for the long-term control of bagworm pests.

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