Biological Control of the Coconut Moth, *Batrachedra arenosella* by *Chelonus* Parasites in Indonesia[1]

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ABSTRACT

An experiment was conducted on the island of Flores, Indonesia, to test for biological control of the coconut moth, *Batrachedra arenosella* Walker, by introducing the braconid parasite *Chelonus* sp. Six and twelve months after releasing 5 gravid females of *Chelonus* per 4 ha of moth-infested coconuts, the percentage infection of the host pupae, the distribution capacity and the population density of the parasites were determined at 0, 50 and 100 m from the point of release. The results of the experiment show that the percentage of parasitized host pupae and population density of the parasite 0 and 50 m from the point of release were approximately twice that found at 100 m. This suggests a slow outward spread of the parasite from its point of introduction. There were only slight increases after 12 months in these parameters and in the percentage of spathes where *Chelonus* was found when compared with results after 6 months. These results suggest that the parasite has become established but spreads out slowly from its point of introduction. There was only a slight reduction in pest population following release of the parasite during the 12-month period.

The coconut moth, *Batrachedra arenosella* Walker, (Lepidoptera; Cosmopterygidae) is a serious pest of coconut palm (*Cocos nucifera* L.) in Indonesia (Tjoa, 1953; Kalshoven, 1981). Larvae of the moth cause extensive damage to coconuts, feeding on the male and female flowers in unopened spathes. The insect is regarded as the third most serious coconut pest in Indonesia (Samino, 1981; Baringbing et al, 1984). The pest has been established for many years and at least 35,000 ha are now heavily infested, mostly in the provinces of Nusa Tenggara Timur, Nusa Tenggara Barat, Sulawesi Tengah and Bengkulu (Baringbing et al, 1984). Many attempts have been made, by mechanical, biological and chemical methods of control, to reduce the population density of the pest (Kasumbogo, 1973; Baringbing and Bariyah, 1977).

The biological control method uses *Chelonus* sp. (Hymenoptera; Braconidae) that introduced to the island from Java, which infects the egg and parasitizes the larval and pupal stages of the moth. It was successfully reared in the laboratory by Baringbing (1984) using the potato pest, *Phthorimaea operculella* Zeller (Lepidoptera; Gelechiidae), as its host since the target moth, *Batrachedra*, cannot be reared in the laboratory (Baringbing, 1982). Under laboratory conditions, female parasites gave an average of 14 offspring, with a male:female sex ratio of 2.27:1; the sex ratio of the same braconid in the field, with *Batrachedra* as its host, was 1:1. The incubation period of the parasite was 26 days for males and 27 for females in the body of *P. operculella*. From each pupa only one adult parasite emerges.

The objective of the experiment was to study the capacity of *Chelonus* to infect the host and to determine its establishment at distances of 0, 50 and 100 m from the point of release after 6 and 12 month periods.

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MATERIALS AND METHOD

Releasing the parasites in the field

Groups of five gravid females of *Chelonus* parasites, reared in a pest laboratory at Nita, were placed in glass tubes and then released in the crown of mature coconut palm attacked by the coconut moth, *B. arenosella,* in an area where this species of braconid had not previously been found. In the experiment, 50 gravid females of *Chelonus* were released in 10 groups, one group to each 4 ha of *Batrachedra*-infested coconuts. The coconuts were between 25 and 30 years old and planted at a spacing of 9 to 10 m (ca. 100 trees per ha). The experiment was located in the coconut village of Mekendetung (elevation 350 m), Sikka regency, Flores island, Nusa Tenggara Timur province, Indonesia.

Observations

Observations were taken twice, 6 and 12 months after releasing the parasites in the field. In each 4 ha plot, spathe samples were collected from the tree in which parasites had been released plus 16 other trees located along the major compass points in two rings at 50 and 100 m from the central tree. The sampled spathes were in position # –1 (the spathe next to open) in which moth pupae are normally found. This process was repeated in each of the plots; 170 spathes were thus collected. Pupae of *Batrachedra* collected from each spathe were counted and placed in 170 plastic containers of 100 ml capacity and reared in the laboratory. The numbers of adult parasites emerging from the pupae over the following 15 days were recorded to investigate the extent of braconid infection in the host. This was expressed as "infection capacity" or percentage of collected parasitized by *Chelonus.* The "distribution capacity" (percentage of spathes in which *Chelonus* was found) and the "population density" (number of *Chelonus* adults per spathe) were also calculated from the data.

Figures recorded as percentage were angularly transformed before all data were subjected to analyses of variance.

RESULTS AND DISCUSSION

The results of the experiment are shown in Table 1.

The percentage of moth pupae parasitized (= infection capacity) at 0 and 50 m from the point of release was significantly different ($P<0.05$) from the percentage found at 100 m, approximately twice as many being found near the point of release (Table 1). Similarly, the distribution capacities and population densities of *Chelonus* were much higher near the point of release although these differences were not significant at $P = 0.05$. High coefficients of variation, largely resulting from the poor or the absence of parasite establishment in some plots, probably accounts for this lack of significance. These observations suggest that the parasites remained clustered around their points of release, particularly during the first 6 months.

There were also significant differences (Table 1) between the 6- and 12-month observations in most of the parameters studied, which suggest an increasing activity of the parasite with time. Such differences might however be seasonal. Longer term studies of host and parasite populations will be needed to determine the permanence and stability of the introduced parasite population. There were indications of reduced pest activity after 12 months which may have resulted from the parasite release.

Since the parasite appears to spread out slowly from its point of release it is tentatively recommended that, in any further attempts to control the moth in the

TABLE 1. Observation of *Chelonus* parasites 6 and 12 months after releasing in the area infested by *Batrachedra*.

	Sampling time					
	6 months		12 months			
	Distance from point of release		Distance from point of release		Significance level	
	0 & 50 m	100 m	0 & 50 m	100 m	Distance	Time
% of spathes infested by *Batrachedra*	100.00	92.50	80.00	77.50	ns	***
Population density of pest (No. of *Batrachedra* per spathe)	9.87	8.21	5.48	5.74	ns	*
Infection capacity (% of pupae parasitized)	11.16	6.53	14.08	8.52	*	*
Distribution capacity (% of spathes with *Chelonus* per spathe)	27.78	15.00	30.00	25.00	ns	ns
Population density of parasite (No. of *Chelonus* per spathe)	0.61	0.38	1.39	0.70	ns	*

* and *** denote $P<0.05$ and <0.001 respectively

field, five gravid *Chelonus* females should be released at each 50 m spacing (5 females per ha), that is at four times the density released in the present experiment.

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