

# Biological Study and Rearing Techniques on Bamboo Caterpillar, *Omphisa fuscidentalis* Hampson

Leela Kayikananta

*Forest Products Research and Development Division, Royal Forest Department, Chatujak,  
Bangkok 10900, Thailand*

Biological study on the reproduction of *Omphisa fuscidentalis* Hampson showed that the adults fly to mate during the night, after that female moths lay the mass of 80-130 white eggs on the bamboo sheaths mostly at the base of bamboo shoot. Upon hatching, the first stage of young larvae were pale brown, then they arranged themselves into long rows heading to find a suitable internode for infestation. The group of larvae assists one another to bore an entrance hole within one day and would mutually bore the exit hole for the adults emergence mostly from the fifth to tenth internodes within one day, after entering the bamboo shoot. The color of larvae became white within three days. After larvae were 45-60 days old, they moved down and congregated in the internode with existing exit hole for eight months. Therefore, the proper collecting technique should be done after their congregation with the best period from January to April. As the result, bamboo caterpillars could be obtained from the specific internode and the infested bamboo culm could be harvested for later utilization.

There are two mass rearing technique methods of bamboo caterpillar, *Omphisa fuscidentalis*. The first method is controlled mating in the nylon-net cage covering bamboo shoot. The second method is released moths for natural mating into the bamboo shoot plot. The latter is the best rearing technique because it is easy and convenient.

Bamboo host plants comprised of 4 genera and eleven species, namely *Dendrocalamus membranaceus*, *D. strictus*, *D. hamiltonii*, *D. asper*, *D. giganteus*, *D. brandisii*, *Bambusa nutans*, *B. vulgaris*, *B. arundinaceae*, *Gigantochloa nigrociliata*, and *Thyrsostachys oliveri*.

## Introduction

Bamboo caterpillars are the most popular edible insect in the northern part of Thailand. Previously it was the supplementary food for hilltribe and rural people who resided near bamboo forest. For the past ten years, it has been well known not only to the local people, but also to foreigners, such as

Taiwanese and Koreans. Most of them would like to taste it, regardlessly how expensive it will cost. The taste of bamboo caterpillar is distinctively delicious with bamboo flavor. Bamboo caterpillars now are high price products. In the restaurant, one plate of caterpillars costs about 50-100 Baht. At fresh market in Mae Sai district, Chiang Rai province, uncooked worms were sold at 250 Baht per kilogram, while in Chiang Mai province they cost 500 Baht per kilogram. The price depends on sale site, rural or downtown, and sale time. It can be said that bamboo caterpillar is one of the economic insects which can give high incomes for hilltribe and rural people. At present, the bamboo caterpillars are collected from the natural bamboo forest. Most local people and hilltribe people do not know about bamboo caterpillars' life cycle. They know only that the caterpillars inhabit inside bamboo culm. In consequence, natural bamboo forest was fast decreased because the bamboo shoot was cut down to collect the caterpillars from each internode. Following of such collecting, the insect will sooner or later become extinct in the near future. Therefore, it is highly worthwhile to study the biology and ecology of the bamboo caterpillar and to find the technology for rearing.

The details on biological and ecological studies have been done and reported (Kayikananta, 1994). Bamboo caterpillar, *Omphisa* sp. Family Pyralidae, the moth has orange-brown wings with distinctive black curved stripes. The male has wing span of 4 cm and the body is 2 cm long, while those of the female 4.5 cm wings span and 2.2 cm body length. Sex ratio of male : female is 1:1. The adults come out of the internode from the exit hole of 0.5 cm wide and 1 cm long, prepared by the larvae. Adult period is from July-August. Bamboo caterpillar has white body, of 3.5-4 cm long. The larvae bore an exit hole for adults at the internode and keep boring inside through the upper nodes to feed on young tissue and membrane and finally disperse through about 26 internodes. After that they move down and congregate in the internode with existing exit hole to pupate. The pupation occurs under the dividing wall of the node by hanging their heads downward. Larvae grow very fast. Only about two months, they are big enough to be sold. Larvae longevity is about 10 months. While pupal period about 46-60 days. Life cycle is one year.

*Omphisa* sp. spend the whole life in only one bamboo culm and doing no harm to the bamboo host, so it can grow into bamboo culm. Only the inside color of bamboo wood, changed to brown. Therefore, *Omphisa* sp. is not considered to be the pest of bamboo tree but the beneficial insect.

The objectives of the research can be listed in 5 categories:

1. To study the biology, concerning mating, egg laying, egg hatching, behavior of larvae boring the entrance and emerged holes.
2. To study the exact larvae congregation time.

3. To survey the host plants of bamboo caterpillar.
4. To analyze nutritional value of bamboo caterpillar.
5. To search for good and promising rearing technique.

This experimental research was taken place in national bamboo forest and bamboo plantation area in Lampang province, Chaingrai Province and Phetchaboon Province. Some samples were brought in for identification by stereomicroscope at The Royal Forest Department. Nutritional value was analyzed at Kasetsart University.

### **Material and Methods**

The preparation of adult for study purpose and rearing experiment of bamboo caterpillar from the larvae through adult emergence was executed in four methods

1. Culturing the larvae in the original bamboo shoots
2. Removing the larvae from the original bamboo culm to the new needed ones
3. Cutting the internodes with the larvae inside to be cultivated in given location
4. Cutting the internodes with the larvae inside to be cultivated in water.

Bringing the nylon-net cages to cover the whole part of bamboo with larvae inside to keep the newly emerged adults for the next experiments.

#### *Biological study*

1. Observing the insect mating behavior in the cage and in natura habitat. Checking number of eggs hatching, behavior of boring into the shoots including boring out the exit hole for the adult emergence.
2. Checking the larvae congregation by making hole above the already bored hole internode when the larvae were 30, 35, 40, 45, 50, 55 and 60 days old.

#### *Nutritional value analysis*

Boil and oven-dry seven months old larvae to get, 100 gm of sample for the analysis of nutritional value, percentage of protein and fat. The analysis was carried out at Kasetsart University.

#### *Study of host plants*

1. Talking to people who used to collect bamboo caterpillars.
2. Surveying area of this insect existing in the bamboo forest, taking apart bamboo to record the number of caterpillars, diameter and

thickness of each bamboo type and detail of each bamboo type for classification

3. Observing quantity of bamboo types chosen to be their habitats and comparing the number of infested bamboo shoot on each species in that area.
4. Observing bamboo forest area of each bamboo type.

***Rearing experiment of the bamboo caterpillars by controlled mating covering bamboo shoots***

Sewing nylon-net into cylindrical bag cages with 4 different sizes of diameter and length, including 26 x 100, 36 x 150, 45 x 200 and 55 x 200 cm, choosing bamboo shoots with height from 20-200 cm, covering them with the prepared nylon-net cages, releasing 1-4 males and 1-4 females per one shoot, letting them mate and laid eggs in the enclosed bamboo shoots, checking the result every day until the adults were all dead, then taking off the nylon-net cages. Rechecking on eggs hatching and the larval boring.

***Rearing experiment by releasing the moths for natural mating into the bamboo shoot plots***

1. Surveying the bamboo forest area.
2. Dividing the area into 3 experimental plots of about 2,500 m<sup>2</sup> per plot, surrounding each plot with straw-rope.
3. Adult moths were released into plot No 1 and No 2, whereas plot No 3 was used as a control with no moths released.
4. When the adult emergence, bring the portion of bamboo with adult inside into the experimental plot for releasing. Letting them naturally mate and lay egg on shoots of their choices.
5. Daily checking of those shoots when egg laying were found, after releasing the adults until they were dead.
6. Rechecking the boring of entrance holes of the larvae.

**Results and Discussion**

***Biological study***

*Reproduction* : The pair of moths flied to mate around bamboo shoot at night. Then, the female laid a mass of eggs, about 80-130 eggs per mass on bamboo shoot sheath, mostly at the base of shoot. The egg was small, round with diameter about 1.4 mm, dip-white and glassy. Eggs were overlapped in one group, of size 0.7 x 0.7, 1 x 1 and 1 x 2 cm. After the color of eggs changed from white to pale brown, young larvae emerged from the eggs in 12 days.

**Infestation :** First instar larvae were pale brown with long hair and the body is 1.7 mm long. They arranged themselves into long row heading for best internode for infestation, then the group of larvae work together to bore an entrance hole at internode within one day. The larvae together bore the exit hole for the adult emergence and finished in one day, after they entered the shoot. The exit hole could be spotted from the second to the fourteenth internode, but mostly from the fifth to tenth internode. (Table 1, analyzed from 55 bamboo shoot samplings.). The exit hole could also be found at the same internode of the entrance hole or at the first or second upper internode. The larval color became white within three days.

**Table 1. Frequency of exit holes at each internode of bamboo shoots.**

	No. of internode															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Frequency of exit holes	0	2	0	2	9	5	8	7	8	10	3	0	0	1	0	-

**The congregation of larvae :** After larvae consumed enough of the membrane and young tissue for 45-60 days, they would migrate down and congregate at the exit hole internode for another eight months. Therefore, the larvae could be easily collected from the specific internode, which is the right collection method. The bamboo culm should not be cut down in order to collect larvae from each internode.

#### **Analysis of nutritional value on bamboo caterpillar**

Bamboo caterpillar, *Omphisa fuscidentalis* was found to have high nutritional value, composed of protein 26.29% and fat 50.54%, which are as good as food.

#### **Host plants of *Omphisa fuscidentalis***

The bamboo of four genera and eleven species were found as host plants, (Table 2). All of them are thick wood bamboo, of more than 0.5 cm. The number of larvae, depended on the size of bamboo culm, for examples in *Dendrocalamus strictus*, *D. membranaceus* and *D. hamiltonii* with diameter of greater than 6.5 cm, the number of larvae were about 80-178 per culm. In *Thyrsostachys oliveri* with diameter of 4-7 cm, the number of larvae were found to be less than 80 per culm. In bamboo forest in northern Thailand, the majority of bamboo species are *Dendrocalamus strictus*, *D. membranaceus* and *D. hamiltonii*, where bamboo caterpillar sold in market were collected. The most preferred bamboo species are *D. hamiltonii* and *Gigantochloa nigrociliata*. Shoots of these two species, were found to be

Table 2. Host plants of bamboo caterpillar, *Omphisa fuscidentalis* Hampson

No.	Scientific name	Local name	Size (cm)		Level of preference	Collected caterpillar in each bamboo species
			Diameter	Thickness		
1.	<i>Dendrocalamus strictus</i> Munro	Pai Saang Doi, Pai Saang Nuan	6.5-11.5	0.5-1.8	***	####
2.	<i>Dendrocalamus membranaceus</i> Nees	Pai Saang	6.5-10	0.8-1.5	***	####
3.	<i>Dendrocalamus hamiltonii</i> Nees	Pai Hok	6.5-13.5	0.6-2	****	###
4.	<i>Dendrocalamus asper</i> Backer	Pai Dtong	8-15	1-2	***	##
5.	<i>Dendrocalamus giganteus</i> Munro	Pai Pok	8-18	2-3.5	***	##
6.	<i>Dendrocalamus brandisii</i> Kurz	Pai Bong Kai, Pai Bong Ban	6-9	1-2	***	##
7.	<i>Bambusa nutans</i> Wall	Pai Bong Paa, Pai Bong	5-7	1-2.5	***	##
8.	<i>Bambusa vulgaris</i> Schrader	Pai San Cam, Pai Leuang	5-8	0.6-2.5	*	#
9.	<i>Bambusa arundinaceae</i> Willd	Pai Paa, Pai Naam	6-9	1.5-2.5	**	##
10	<i>Gigantochloa nigro-ciliata</i> Munro	Pai Rai Lor	4.7-7.5	1.3-2.3	****	##
11.	<i>Thyrsostachys oliveri</i> Gamble	Pai Ruakdam	4-7	0.8-2.3	*	#

Note  
 \*\*\*\* = very high preferred species  
 \*\*\* = high preferred species  
 \*\* = medium preferred species  
 \* = low preferred species

#### = very high collected species  
 ### = high collected species  
 ## = medium collected species  
 # = low collected species

about 2.8 times infested them more than *D. strictus*, and *D. membranaceus* was infested.

***Rearing experiment by controlled mating in nylon net cage covering bamboo shoot***

Total of 248 moths (Table 3) released in controlled mating into 50 nylon-net covering bamboo shoots. Twelve bamboo shoots were succeeded in mating and infestation, with 38 shoots non-infested. The sex ratio of male per female equals 1:2, 1:3, 1:4, 2:2, 2:3, 3:2, 3:3, 4:2, 4:4. It could proceed mating and also succeeded in infestation. Therefore, the supplementary rearing, should depend on the health of bamboo moths.

**Table 3. Ratio of male and female used in controlled mating test and number of infested and non-infested bamboo shoots.**

No. of adults male : female	No. of infested bamboo shoots	Number of non - infested bamboo shoots
1:1	0	1
1:2	2	2
1:3	1	2
1:4	1	1
2:1	0	1
2:2	2	11
2:3	1	4
2:4	0	0
3:1	0	0
3:2	1	6
3:3	1	8
3:4	0	0
4:1	0	0
4:2	1	1
4:3	0	1
4:4	2	1
Total	248	12
		38

Using nylon net bag cage of four sizes of 26 x 100, 36 x 150, 45 x 200 and 55 x 200 cm, the efficiency of infestation were found to be 14.2%, 21.4%, 50% and 50%, respectively (Table 4). It was apparent that the size of cage affected the mass rearing, and large size should be use. The bamboo shoots were mostly infested at about 30-160 cm height, therefore further study should be considered. In this experiment, the large cage could limit only four cages because there were no more bamboo moths emerged and

bamboo shoots were also too high and too old. Therefore, this experiment recommended to be repeated.

Table 4. Controlled mating in nylon-net cage covering bamboo shoots.

Size of bag cage Diameter x length (cm)	Number of experimental bamboo shoots	Number of infested bamboo shoots.	Efficiency of infestation (%)
26x100	14	2	14.2
36x150	28	6	21.4
45x200	4	2	50
55x200	4	2	50
Total	50	12	

*Rearing experiment by releasing adults for natural mating into bamboo shoot plots*

The total number of male and female released in plot No 1 and plot No 2, was 286 moths and 122 infested bamboo shoots found in tree plots (Table 5). The moths laid eggs 1-3 times in some shoots. In one big bamboo shoot the moths laid eggs 7 times, with about 550 larvae hatched in that bamboo culm. In controlling plot, 8 bamboo shoots were found infested. Since the bamboo forest area was limited, experimental plots were not really far separated. The furthest infested bamboo shoot was far from the portion of bamboo moths about 250 m, so the moths could fly into the control plot to lay eggs. If there were enough host plants in that area, it would not fly long distance to find them. The result of this experiment showed high capacity reproduction because all adults did not fly far away so they could mate and lay eggs in the experimental plot.

Table 5. Releasing moths for natural mating into bamboo shoot plots.

Plot No.	Number of released male and female	Number of infested bamboo shoots
1	87	28
2	199	86
3	control	8
Total	286	122

## Conclusion

*In rearing Omphisa fuscidentalis Hampson, bamboo caterpillar:* two rearing methods were employed.

*Method 1.* By controlled mating in nylon-net covering bamboo shoots. This rearing method was complicated since the adult can be affected from the environments, such as rain, sunshine heat and enemies. The success of this method is about 50 percent in large cage. Therefore, the research should be further investigated on improving the technique, such as the size of covering bag cage which should be more than 45 x 200 cm, covering the whole bamboo shoot, etc.

*Method 2.* By releasing the reared moths into bamboo shoot area for natural mating. This experiment is quite successful and is considered to be the best rearing method for promotion. This method was very easy, convenient, economy, less time consuming and high efficiency. The number of larvae obtained from this rearing method were about 80-550 per culm since the moths could oviposit 1-7 times per bamboo shoot. In natural bamboo culm, the number of larvae varied widely with highest number of 178. There are 11 species of bamboo host plants that could be used in rearing the bamboo caterpillars (Table 2). The careful management should be applied with enough number of bamboo shoots to the number of released moths.

*Collecting technique :* The best time for collecting bamboo caterpillars is after they move down to congregate, when the larvae were 45-60 days old. But it would be even better, if they are left along until January to April, because the larvae will grow bigger with delicious taste, and 26.29% protein. Collecting is done by cutting in a rectangular hole, about 9 x 13 cm<sup>2</sup> at specific internode housing the bamboo caterpillars. They can be collected quite easily and sold in the market at high prices during such period. Generally, the infested bamboo culm are stronger than the uninfested ones, since the cell of wood is small and dense, making them stronger and heavier than the normal bamboo. They can be utilized in several other ways, such as the supporting poles on the branches of lichi and longan trees, bamboo handicraft and construction poles, etc.

It can be seen that rearing bamboo caterpillar with proper management is not difficult. The rearing technique of bamboo caterpillars should be extended to the ethnic and rural people, so that they could earn extra incomes. Forest area of bamboo plantation could be increase for rearing, as indirect environment conservation. It is suggested to collect bamboo caterpillar during January to April, so that there will be bamboo caterpillar for food and bamboo culm for sustainable utilization. Moreover, it will also

protect the damaging of bamboo forest and develop the quality of people life with extra protein getting from this insect.

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