LIFE HISTORY AND BEHAVIOR OF THE FIG MOTH, *Cadra cautella* Walker, AS AFFECTED BY VARYING MOISTURE LEVELS OF COPRA

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ABSTRACT

Life cycle was longer, and fecundity of females and percent hatchability of eggs were lower when moths were reared on copra with 3 to 4% moisture content than when they were reared on substrates with 5 to 14% moisture content. Longevity, feeding, mating and oviposition behavior of adults were not significantly affected by the moisture levels tested. No significant difference in the life history of the insect was observed during the first and second generation.

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KEY WORDS: *Cadra cautella* Walker. Life history. Behavior. Moisture level.

INTRODUCTION

The fig moth, *Cadra cautella* Walker, is an important insect pest of high-value commodities and packaged consumer goods (Kranz et al., 1977). It preferably attacks poor quality copra in storage. Thampan (1975) and Child (1974) reported that the deterioration of copra caused by insects including the fig moth is linked with spoilage due to molds.

The use of chemicals to control this pest has been successful. However, warehouse owners should be very careful in using them because pesticide residues may contaminate the products and lower its marketability. Moreover, *C. cautella* has been shown to be tolerant to a number of commonly used insecticides such as DDT, Lindane and Malathion, and is expected to acquire resistance to other insecticides in areas of extensive and protracted use (Kranz et al., 1977).

Physical control can also be used to combat this pest. Hill (1975) reported that modifying the environmental conditions controlled storage pests by adversely affecting their survival and development. For example, copra beetle can be con-

trolled by properly drying copra (Lever, 1969). Furthermore, Ombrosa (1982) found that non-moldy copra with low moisture content had a detrimental effect on the copra beetle, *Necrobia rufipes* de Geer, indicating that moisture content greatly influenced the survival and population build-up of said insect pest. Because of the potential of minimizing moisture level as a control method, it was felt that a similar study on the fig moth, another insect pest of copra, should be undertaken to find out the effect of varying moisture levels of copra on the insect's life cycle and behavior.

MATERIALS AND METHODS

Determination and Maintenance of Moisture Levels

A preliminary study was conducted to determine the appropriate moisture levels of copra to be used as treatments. The six moisture levels used in this study were: 3-4%, 5-6%, 7-8%, 9-10%, 11-12% and 13-14%. These levels were chosen since they represent the moisture content of the different copra samples under storage.

Copra samples with the desired moisture levels were prepared in the copra drier of the Regional Coconut Research Center at ViSCA, Baybay, Leyte. Copra samples with 13 to 14% moisture content were taken from the drier after 10 hours. Other samples were removed from the layers of the drier after 18 to 24 hours to get copra with moisture contents ranging from 5 to 12%. Copra with 5 to 6% moisture content was placed in the oven for 4 more hours to get copra with 3 to 4% moisture content since this moisture level cannot be attained directly from the drier. To maintain the desired moisture level, prepared copra samples were stored in sealed plastic bags which were then placed in a Lab-line Ambi-Hi-Lo Chamber at 10°C for a month.

Copra cubes (1.5 cm^3) taken from the copra samples were grated and placed in three calibrated pans. Each of the three pans containing the samples was weighed and these were then placed in an oven at 110°C. After 5 minutes, the pans were removed from the oven and placed in a Direkto moisture meter one at a time to determine the levels of moisture present in the samples.

Mass Rearing of Insects

Initial population of the fig moth was collected from infested copra stored in the laboratory of the Department of Plant Protection. The adults collected were placed in jars (18 cm H x 10 cm D) which were covered with nylon tulle and contained copra with 7 to 8% moisture content. This moisture level is said to be the most stable for copra (Pers. comm. with Hinay, Regional Coconut Research Center at ViSCA). The population of fig moth was allowed to build up for at least two generations.

Adults were transferred to fresh, uninfested copra at the same moisture level and were allowed to mate

and lay eggs. Resulting eggs were incubated at room temperature and the newly-hatched larvae were used for the study of the life history and behavior of the fig moth at different moisture levels.

Life History and Behavior at Different Moisture Levels

Fifty first-instar larvae were used as samples per treatment for each generation. They were reared in jars (7 cm H x 5 cm D) containing copra with the designated moisture level as food. Copra was replaced every other day to maintain the moisture content of the substrate. Changes in the morphology, development and behavior of the insects were observed with the aid of a stereoscopic microscope. The duration of the developmental stages, mortality at various stages of development, fecundity, percent hatchability, sex ratio, and behavior of the pest were also noted.

Data gathered from each generation were analyzed separately using Scheffe's test to determine the effect of varying moisture levels on the life cycle of the insect in succeeding generations.

RESULTS AND DISCUSSION

Tables 1 and 2 show that copra with 3 to 4% moisture content was unfavorable for the development and population build-up of the fig moth. The developmental period was longest, fecundity of adults and percent hatchability of eggs were lowest and mortality was highest on fig moths reared on copra with this moisture content. The shortened life cycle of the moths reared on copra with higher moisture content could be due to enhanced biochemical changes in copra brought about by the presence of molds. These biochemical changes probably resulted in rapid release of free fatty acids, thereby making copra a suitable food for the insects and hastening the insects' development. On the other hand, death of larvae reared on copra with 13 to 14% moisture content might be caused by the presence of unidentified predators covered by the thick molds or by the escape of larvae from the rearing jars.

Mated females reared on copra with 13 to 14% moisture content had the highest number of eggs among the six moisture levels used while those reared on copra with 3 to 4% moisture content produced the lowest number of eggs. Ombrosa (1982) reported that high fecundity of insects reared on copra with high moisture content might again be due to the presence of molds.

The highest percent hatchability of eggs was observed on insects reared on copra with 13 to 14% moisture content (Table 2). Eggs laid by female moths reared on copra with 3 to 4% moisture content had the lowest percent hatchability. It was observed that eggs got desiccated on dry copra.

The sex ratio was not affected by the moisture content of copra. Adult longevity did not significantly differ at varying moisture levels.

Table 1. Average duration (days) of the different developmental stages of the fig moth, *Cadra cautella,* reared on copra with varying moisture levels.[1]

Moisture Content of Copra (%)	Developmental Stages[2]				Total Developmental Period
	Incubation Period	Larval Period	Prepupal Period	Pupal Period	
3-4	3.56 ± 0.91a	31.84 ± 4.58a	7.66 ± 1.99a	6.80 ± 1.65	49.86 ± 9.13a
5-6	2.85 ± 0.74b	18.62 ± 1.48b	5.52 ± 1.82b	7.04 ± 1.30	34.06 ± 5.34b
7-8	2.77 ± 0.68b	18.14 ± 1.65b	5.26 ± 1.75b	7.04 ± 1.22	33.21 ± 5.30b
9-10	2.44 ± 0.66b	18.22 ± 2.83b	5.72 ± 1.34b	7.06 ± 1.25	33.44 ± 6.08b
11-12	2.52 ± 0.69b	18.25 ± 2.07b	5.55 ± 1.29b	7.05 ± 1.46	33.38 ± 5.51b
13-14	2.89 ± 0.52b	17.49 ± 1.89b	5.13 ± 1.41b	7.62 ± 1.51	33.13 ± 5.33b

[1] Means followed by a common letter are not significantly different at 5% level using Scheffe's test.

[2] Data based on 50, 68, 66, 55, 56 and 47 individuals reared on copra at T_1, T_2, T_3, T_4, T_5 and T_6, respectively.

± Standard Deviation.

Table 2. Some biological characteristics of fig moths reared on copra with varying moisture levels.[1]

Moisture Content of Copra (%)	Fecundity[2]	Hatchability[2] (%)	Sex Ratio	Longevity (days)[3]	Mortality[4] (%)
3-4	133.86 ± 20.99a	80.18 ± 4.40a	1:1.4	6.60 ± 2.18	47
5-6	149.75 ± 22.18ab	87.51 ± 5.58b	1:1.2	6.57 ± 2.36	25
7-8	156.40 ± 33.42ab	89.01 ± 5.40b	1:1.5	6.88 ± 1.95	21
9-10	160.44 ± 21.75ab	91.23 ± 3.99b	1:1.4	7.46 ± 1.73	25
11-12	170.44 ± 20.04b	91.38 ± 4.39bc	1:1.3	7.21 ± 1.90	26
13-14	180.42 ± 24.95b	94.71 ± 2.25c	1:1.2	6.55 ± 2.11	17

[1] Means followed by a common letter are not significantly different at 5% level using Scheffe's Test.

[2] Data based on 29, 36, 40, 32, 32 and 26 individuals reared on copra at T_1, T_2, T_3, T_4, T_5 and T_6, respectively.

[3] Data based on 50, 68, 66, 55, 56 and 47 individuals reared on copra at T_1, T_2, T_3, T_4, T_5 and T_6, respectively.

[4] Data based on 100 individuals.

± Standard Deviation.

This is expected since the fig moth does not feed on copra during the adult stage.

Lowering the moisture content of copra to 3 to 4% appeared to result in high mortality of fig moths. This may be due to the dryness of copra which presumably caused the larvae to have difficulty in feeding, or to the desiccation of larvae reared at low humidity. The absence of molds on copra with low moisture content seemed to make the food unfavorable for the development, survival and population build-up of the fig moth. Thus, it is possible to control infestation of copra with *C. cautella* by properly drying the copra to eliminate molds. However, the effect of other physical factors such as temperature and relative humidity must be taken into consideration in order to have a more reliable basis in the formulation of efficient control measures.

Effect of Varying Moisture Levels of Copra on the Behavior of the Fig Moth

Feeding Behavior

During the entire study period, there were no observable changes in the behavior of the moths reared on copra with varying moisture levels. Feeding started a few minutes after each molt. The most preferred feeding site of *C. cautella* was the surface of the copra, whether moldy or non-moldy, probably due to its softness. Similar observations were reported by Child (1974) and Blancaver et al. (1977).

Mating and Oviposition Behavior

Mating behavior was also not affected by varying moisture levels of copra. However, mated females reared on copra with 3 to 4% moisture content oviposited 3 to 4 days after mating while those on copra with 5 to 14% moisture content oviposited 2 to 4 days after copulation. The duration of the oviposition period was likewise not influenced by the moisture content of the food.

IMPLICATIONS

Controlling storage pests by the moisture regulation method seems promising. However, it is not practical for farmers to dry their products just to attain the 3 to 4% moisture content unless good quality copra will be given premiums. Anyway, copra prices are largely determined by weight and less by quality. Besides, this method is feasible only under small-scale storage conditions. Its feasibility also greatly depends upon the length of time the products are stored in the warehouses before being transported and processed. Furthermore, storage conditions are greatly affected by the design of the building and the prevailing environmental conditions during the season.

LITERATURE CITED

BLANCAVER, R.C., ABAD, R.G., PACUMBABA, E.P. and MADAMBA, J.C. 1977. Guidebook on Coconut Pests and Diseases. Davao Research Center, PCA - Agricultural Research Branch, Bago-Oshiro, Davao City.

CHILD, R. 1974. Coconut. Tropical Agricultural Series, 2nd ed. Longman Group Ltd., London, pp. 246-249.

HILL, D.S. 1975. Agricultural Insect Pests of the Tropics and Their Control. Cambridge Univ. Press, Cambridge. pp. 18-280.

KRANZ, J., SCHMUTTERER, H. and KOCH, W. 1977. Diseases, Pests and Weeds in Tropical Crops. Verlag Paul Parey. pp. 441-443.

LEVER, R.J.A.W. 1969. Pests of the Coconut Palm. FAO Rome. FAO Agric. Study No. 77:152-157.

OMBROSA, C.F. 1982. Life history of the copra beetle, *Necrobia rufipes* de Geer, when reared on moldy and non-moldy copra and preference on the two substrates. Unpublished B.S. Thesis, Visayas State College of Agriculture, Baybay, Leyte. 26 pp.

THAMPAN, P.K. 1975. The Coconut and Its Products. Green Villa Publishing House. 244 pp.