

BIOLOGY OF *EPHESTIA CAUTELLA* (WALKER) ON CORN AND ITS COMPARATIVE DEVELOPMENT ON OTHER STORED PRODUCTS¹

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ABSTRACT

The life cycle of *Ephestia cautella* (Walker) on ground corn ranged from 25-45 days with an average of 41 days. The mean duration of the different stages were: egg — three days, larva — twenty-three days, pupa — six days, and adult — nine days. The larva has five to six instars and the mean duration of each was: four days (first), four days (second), three days (third), four days (fourth), two days (fifth), and six days (sixth). Oviposition period was four days.

Based on duration of developmental period and growth index, peanut, cacao seed, sorghum, and yellow corn were most suitable for the development of the insect while mungo, okra seeds, and cassava flour were poor hosts. It could also infest cowpea, rice, flour, wheat and pole beans.

Key words: *Ephestia cautella* (Walker), life cycle, ground corn diet, growth index.

INTRODUCTION

The cacao moth, *Ephestia cautella* (Walker) (Phycitidae, Lepidoptera), is a serious pest of stored products. It is the main pest of cacao beans in the Philippines and has lately been found frequently on milled rice. It was also noted on rice in Indonesia, Malaysia and Thailand by the junior author. In view of the pest potential of *E. cautella* on rice and in the absence of biological information on this pest in Southeast Asia, the life history, habits, natural enemies, and host range of this insect were studied.

This study was conducted from March 1981 to March 1982 at the Stored Product Insect Laboratory, Department of Entomology, University of the Philippines at Los Baños (UPLB), College, Laguna.

¹Received for publication 2 December 1985 and in revised form 19 March 1986. Part of the thesis presented by the senior author to the College of Agriculture, University of the Philippines at Los Baños for the degree of Bachelor of Science in Agriculture (Entomology) under the supervision of the junior author.

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MATERIALS AND METHODS

Insect collection and mass rearing

Larvae and adults were collected from milled rice at the International Rice Research Institute warehouse and reared on ground corn. The adults were allowed to oviposit in inverted empty ball jars with mesh screen covers. To serve as stock culture, the eggs were collected and placed in ball jars filled with ground corn.

Life history and habits

Several pairs of adult moths were allowed to mate and oviposit in empty ball jars. The pre-oviposition period as well as the total number of eggs laid by each female were noted. Eggs were collected daily and placed in petri dishes. The changes undergone by the egg, the incubation period, and eclosion of the larvae were recorded.

The newly hatched larvae were transferred individually to Gerber bottles filled with two grams of ground yellow corn. One hundred larvae were observed daily to determine the number of molts, duration of immature stages, and feeding habits of the insects. The larval head capsules were preserved in alcohol and were used to determine the number of instars. Emerged moths were observed for mating behavior and longevity of the adults.

Host range

Two hundred grams of possible alternate hosts (peanut, sorghum, yellow corn, wheat, rice, cowpea, mungbean, flour, okra seeds, garlic, cassava flour, soybeans, white corn, pole beans, and cacao seeds) were placed in separate ball jars covered with mesh screen. There were three replicates for each host. The samples were disinfested in an oven at 50°C for 48 hours and each replicate was later artificially infested with 100 first instar larvae. The jars were observed daily until adult emergence. The developmental period (egg hatching to death of adults) and the total number of emerged adults were noted. The overall efficiency of the host was evaluated by the growth index (GI): by dividing the percent adult emergence (N) over average developmental period (Av), ($GI = N/Av$) (Chaudhary and Bhattacharya 1976).

Natural enemies

Field-collected specimens were observed for possible emergence of parasites and predators. Collected specimens were referred to Dr. Clare R. Baltazar, Professor and Curator-in-Charge, Museum of Natural History, UPLB, for identification.

RESULTS AND DISCUSSION

Life history and habits

The duration of the different stages of *E. cautella* on ground corn is presented in Table 1. Fig. 1 shows the various stadia of the insect.

Table 1. Life cycle of *Ephestia cautella* (Walker) on ground yellow corn.¹

Stage	Range (days)	Duration (days)
Egg (incubation period)	3	3
Larval instars		
1st	3-5	4
2nd	3-5	4
3rd	2-4	3
4th	3-7	4
5th	3-6	2
6th	3-10	6
Pupa	2-11	6
Adult	3-14	9
Total	25-45	41

¹Data based on 100 individuals.

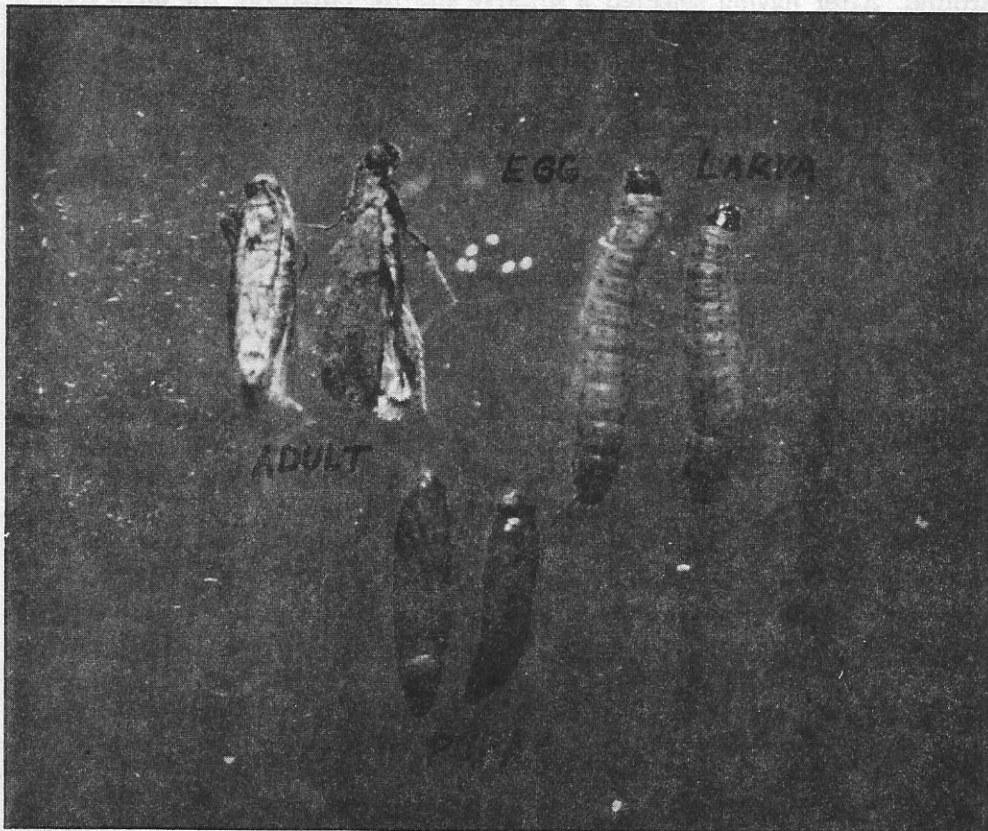


Figure 1. The various stages of *Ephestia cautella* (Walker). Magnification: 10X.

Egg. Eggs were laid singly and scattered over the surface of the food. Only a few eggs were stuck on the container. The newly laid egg was creamy white but gradually turned orange before hatching. The chorion was transparent, making the outline of the larva with its light brown mandible, head capsule, and setae quite visible. Incubation period was three days.

Larva. The larva passed through five to six instars and its total duration ranged from 17-37 days.

The first instar larva was yellowish white with translucent body. Head capsule was light brown with well-developed mouthparts. Setae were light brown. Before the second molt, the prothoracic shield became darker and more distinct and the setae darker brown. In the second instar larva, the dorsal spots began to appear and the body became prominent yellow with a pink tinge. The third instar larva was lighter pink and the dorsal spots more distinct. At the fourth instar, the body of the larva became deeper pink, the dorsal spots very distinct, and the setae dark brown. In the fifth and sixth instar larvae, the body was reddish or deep pinkish and body setae which arise on dark pinnaculum were prominent.

Pupa. When about to pupate, the larva ceased to feed, and gradually became whitish or light yellow. It moved out of the grain and wandered around. After having selected a suitable site for pupation, the larva spun a flimsy silken cocoon. Pupation cells were made by spreading web mats over certain areas until the entire length of the body was covered. The most heavily utilized site was the neck of the jar just below the food surface. This behavior was influenced by the existence of distinct temperature gradients in the container as a result of the rapidly increasing insect population (Graham 1970).

Adult. The newly emerged moth actively crawled out of the pupal case and usually walked and climbed along the walls of the bottle. It remained stationary until the wings attained their full expanse. While still in resting position, the wings snapped back over the body.

Adults were usually active at night, with a late dusk or an early dawn peak of flight activity. Barrer and Hill (1980) described the calling females to be engaged in "turning to face" and "walking up to" orientations directed almost exclusively at locating males; while the noncalling females were engaged in "flying at", "landing near", and "walking into" orientations directed predominantly at wing beating or resting males and occasionally at mating pairs or at calling males. The life span of the adult ranged from 3-14 days.

Damage

Larvae fed on the embryos or softer parts of the seeds. While eating, they spun silken threads, putting the other grains and frass together. The infestation was characterized by the presence of webbings to which frass and grain adhere. The larval cocoon was present sometimes.

Mating behavior

Copulation was not observed right after emergence. After some time, adult females began to adopt the calling position, i.e., raising their abdomens and exposing their pheromone-producing glands while continuously moving their antennae. The male adults, on the other hand, exposed their harpes and kept on moving and flying, looking for partners. Males occasionally walked about or flew for short distances and tried to copulate indiscriminately with females and even with males which they encountered. When the male adult had taken a suitable partner, it bent its head seemingly to smell the female ovipositor until both were facing opposite each other. Copulation occurred anytime of the day but had its peak during the dark period.

Fecundity

Oviposition took place readily in the evening and lasted from three to six days. The moth oviposited readily even in the absence of food with egg laying occurring mostly during the first day. The total number of eggs laid with a single copulation ranged from 224-259. The post-oviposition period of the mated female ranged from one to four days.

Host range

The developmental period and percent emergence of *E. cautella* in different stored products are shown in Table 2. Peanut, cacao seed, sorghum and yellow corn were the most suitable hosts as shown by the short developmental period and high percentage of adult emergence. Tuli and Mookherjee (1963) observed that *E. cautella* likewise could severely damage shelled ground nuts. The feeding takes place in every part of the kernel until the complete kernel is eventually eaten up. He also observed that feeding necessarily starts from the germ point in rice and wheat.

The insect can also develop on various commodities except okra seeds and cassava flour. The development of the insect was longest in mungbean, flour, and cowpea; longer than those reported by LeCato (1976) although the percentage emergence was rather high. Commodities with hard seed coats prevented the larvae from penetrating the seeds resulting in low adult emergence.

The overall efficiency of the food can be judged by evaluating the growth index. Table 2 shows that peanut had the highest value and mungbean had the lowest. The growth index on sorghum and cacao seeds are similar to peanut. The results indicate that these three hosts are equally nutritious to *E. cautella*; conversely, that they are prone to infestation by the insect.

Natural enemies

An unidentified mite species preyed on the eggs of *E. cautella*, and is therefore a potential control agent.

A braconid parasite *Bracon* sp. was observed to attack the second, fifth and sixth instar larvae. Two other braconid parasites, *Bracon* sp. and *Rogas* sp., a pteromalid and a bethylid emerged from the host range culture of *E. cautella*.

Table 2. Developmental period and adult emergence of *Ephestia cautella* (Walker) in different stored products.¹

Hosts	Total developmental period (days) (Av)	% Adult emergence (N)	Growth Index (N/Av)
Cacao seeds	38	68.7	1.82
Cassava flour	0	0	0
Cowpea	48	49.7	1.02
Cake flour	57	36.0	0.64
Mungbean	54	10.0	0.18
Garlic	38	26.7	0.20
Okra seeds	0	0	0
Peanut	37	70.0	1.88
Pole beans	47	25.3	0.54
Rice	39	31.7	0.81
Sorghum	36	65.0	1.80
Soybeans	46	15.3	0.33
Wheat	46	20.7	0.47
White corn	44	14.0	0.31
Yellow corn	42	61.7	1.48

¹ Average of three replicates; 100 larvae per replicate. Developmental period estimated from the one-day old first instar larva to death of the adult.

ACKNOWLEDGMENTS

The authors wish to acknowledge the International Rice Research Institute for providing the initial population of *E. cautella*; Dr. Venus C.J. Calilung, Mr. Ireneo L. Lit, Jr. and Ms. Edralina P. Baldos-Medina for their criticisms and suggestions; Mr. Chito Medina and Mr. Pio Javier for providing the seeds; staff of Stored Product Insect Laboratory for their assistance in the conduct of the study; Dr. Clare Baltazar for the identification of the natural enemies; and Mrs. Lolit Figarola for the final typing of the manuscript.

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