Descriptions of the Immature Stages and Notes on the Biology of Ithome concolorella (Chambers) (Lepidoptera: Cosmopterygidae), a Pest of Kiawe in the Hawaiian Islands[1]

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The cosmopterygid moth *Ithome concolorella* (Chambers), probably a recent immigrant to Hawaii, has been known during the past few years to be a pest of the flowers of kiawe (*Prosopis chilensis* (Mol.) Stuntz) and klu (*Acacia farnesiana* (L.)). Kiawe is the most important source of honey in the Hawaiian Islands and, therefore, some beekeepers contend that this pest is responsible for the low honey production since 1953.

This insect now occurs throughout the Territory. It was reported at the June 8 and July 13, 1953 meetings of the Hawaiian Entomological Society (Notes and exhibitions, 1954) that specimens of *I. concolorella* had been taken on Kauai, Oahu, Maui, and Hawaii. It was collected on Molokai in September, 1955.

A review of the literature revealed that this species was first described and recorded from Texas by Chambers (1875). Little additional information is available about the species. Herein, descriptions of the immature stages of the insect and notes on its biology and damage to kiawe flowers are presented.

I am grateful to Dr. J. F. Gates Clarke, of the United States National Museum, for the identification of this species.

DESCRIPTION

Egg

Milky white when laid; somewhat spindle-shaped or cylindrical with ends rounded. Length about 0.33 mm.; width about 0.12 mm. at middle. External surface glabrous, shining.

Larva

Head brown, remainder of body white to pale yellow. Approximate measurements: first instar, head width 0.12 mm., body length 1.2 mm.; second instar, head width 0.20 mm., body length 1.25 mm.; third instar, head width 0.26 mm., body length 2.26 mm.; fourth instar, head width 0.45 mm., body length 4.13 mm.

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Head capsule: In broadest frontal aspect (fig. 1A), somewhat trapezoidal in general outline. Adfrontal suture (ADFS) meets longitudinal ridge (LR) near or at cervical triangle. Suture between front and clypeus indistinct. Frontal punctures (F^a) approximate, appear to be near dorsal margin of clypeus. Seta Adf^2 slightly ventrad to apex of front. Seta Adf^1 equidistant from Adf^2 and F^1. Puncture Adf^a equidistant from Adf^1 and Adf^2, closer to adfrontal ridge (ADFR) than Adf^1 or Adf^2. Puncture P^b medial to seta P^2, slightly dorsad to line between Adf^2 and P^2. In lateral aspect of head capsule (fig. 1B), seta A^2 slightly dorsad to line between A^1 and A^3, equidistant from A^1 and A^3. Puncture L^a in line with L^1 and A^3, L^1 equidistant from L^a and A^3. Puncture P^a in line with L^1 and P^2, closer to L^1 than to P^2. Puncture A^a in line with A^2 and P^1. Seta 0^1 ventrad to ocellus 2, about equidistant from ocelli 1 and 3; 0^2 caudo-ventrad to ocellus 1. Seta 0^3 equidistant from $S0^3$ and G^1. Puncture 0^a in line with $S0^3$ and 0^2, closer to 0^2 than to $S0^3$. Ocellus 4 closer to 5 than to 6.

Prothorax (fig. 1C): In lateral aspect with setae Ia, Ib, and Ic in almost vertical line; IIa and IIc cephalad to IIb, each about half or less the length of IIb; III, IV, and V directly cephalad to spiracle. Group VI bisetose; group VII with 5 setae. Seta VIII caudo-medial to front legs, near corresponding seta of the other side.

Mesothorax (fig. 1C) and metathorax: In lateral aspect with setae Ia, Ib, IIa, and IIb in vertical line; Ia and IIa each about half or less the length of Ib or IIb; IV equidistant from III and V, III and V shorter than IV. Group VI unisetose; group VII with five setae. Seta VIII as in prothorax, but not as close to corresponding seta of other side.

Abdomen (fig. 1, D, E): Crochets on prolegs of segments 3 to 6 uniordinal and arranged in complete circle, on anal proleg uniordinal and in transverse, semicircular band. Spiracle of segment 8 larger than that of other abdominal segments. In lateral aspect seta III dorsad and slightly caudad to spiracle on segments 1 to 7, dorsocephalad on segment 8. Setae IV and V ventrad to spiracle on segments 1 to 8. Group VI unisetose; group VII trisetose on segments 1 to 7, unisetose on segments 8 and 9. Seta VIII on segments 3 to 6 mediad to prolegs, closer to prolegs than to medial line.

Pupa

Almost white at first, turning brown soon after, and almost black when adult ready to emerge. In ventral aspect (fig. 1F), clypeus-labrum, maxilla, prothoracic and mesothoracic legs, antennae, and wings easily discernible. Wing tips extend almost to posterior margin of seventh segment. Antennae extend to tips of wings. Few scattered, short setae present on abdominal segments. Other parts of head, thorax, and separating sutures of abdominal segments 7 to 10 indistinct (fig. 1G).

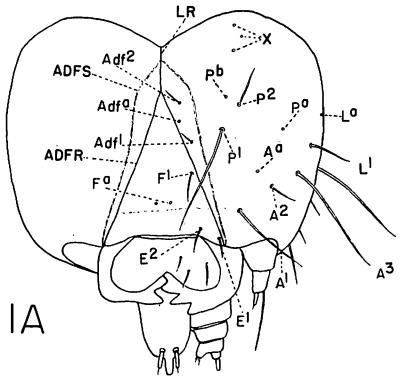
Biology

The egg when laid is milky white and becomes tinged with yellow prior to hatching. It is inserted into the flower bud slightly basad to the level of the apex of the calyx. Usually a light brown spot develops on the external surface of the bud at the site of oviposition. The eggs hatch in three to five days. Eggs in opened buds of klu when allowed to dry under ordinary room conditions did not hatch, whereas eggs in a similar situation, from the same female, kept in a moist environment (covered Syracuse dish lined with moist filter paper) hatched readily. It appeared, therefore, that an environment of relatively high moisture content is required throughout the egg stage for hatching.

The first instar larva usually feeds on the pistil, then on the stamens. It remains in the bud in which the egg was laid throughout the first instar. During this stage the larva, as the egg, seems to require a moist environment and/or moist food, inasmuch as larvae in opened buds when allowed to dry under ordinary room conditions died, whereas those under moist conditions survived. The second instar larva also usually remains in the initial bud but it may bore into an adjacent bud. Subsequently, as the larva develops, it bores into other florets, eating the inner parts of them. The damaged florets are joined together near the entrance holes. Often as many as fifteen kiawe florets are thus joined together in a row, forming a tunnel in which a fully grown larva may be found. Thus a larva may destroy as many as fifteen florets during its development. Upon examination of a few thousand florets of kiawe, eggs, first and second instar larvae were found only in buds and not in open florets, whereas third and fourth instar larvae were found in both open florets and buds.

To determine the number of instars and the duration of each stadium, larvae were reared individually in vials under ordinary room conditions with buds of klu as food. Kiawe buds were not readily available at that time. The data presented in table 1 show that *I. concolorella* has four instars in its larval stage. The mean duration of the first larval instar was 1.0 day; second, 2.0; third, 3.3; fourth, 4.3; and of the pupa, 8.0. If the mean duration of the egg stage is taken as four days, then the mean duration of the entire immature stage of this insect would be 22.6 days.

The larva spins a silken cocoon within which it pupates. In the laboratory, pupation occurred on the bottom of the vial outside of the buds or at the cork stopper of the vial. No pupa was observed on kiawe trees, although damaged florets still hung to the primary axis of the raceme. Many dried, damaged, flower heads of klu on the plant as well as those on the ground were examined but no pupa was found within them. Probably when the larva is ready to pupate it comes out of the florets and drops to the ground to pupate.



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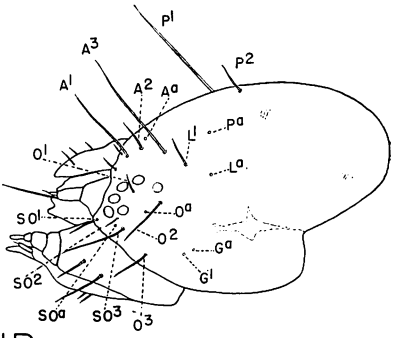

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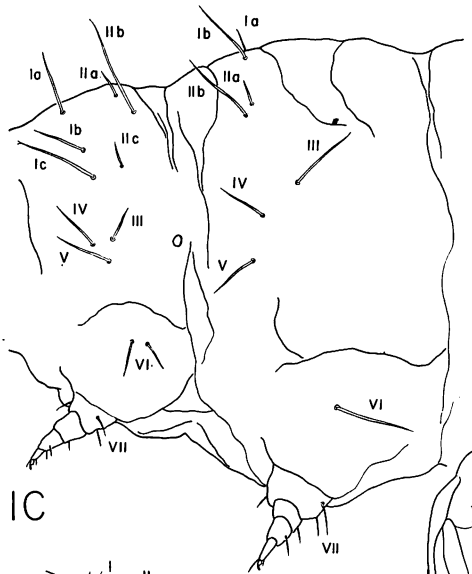

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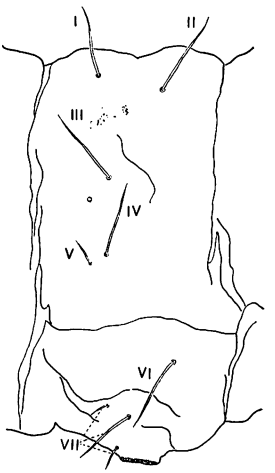

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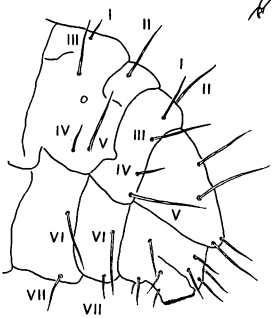

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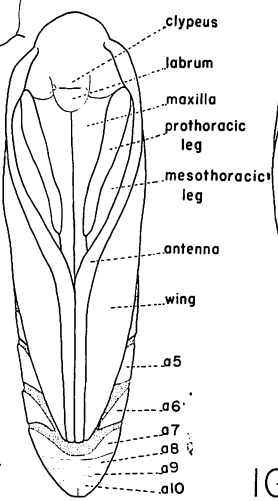

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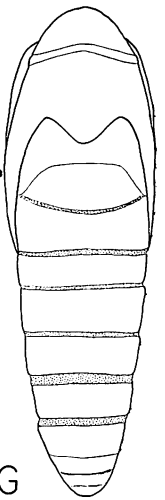

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TABLE 1. Frequency of individuals in each instar with reference to duration.

NO. OF DAYS REQUIRED	INSTARS				
	1st	2nd	3rd	4th	Pupa
1	9	3			
2		3	7		
3		2	6	9	
4		1	6	20	
5			2	15	
6			1	5	1
7					16
8					31
9					13
10					3
Total no. indiv.	9	9	22	49	64
Mean duration (days)	1.0	2.0	3.3	4.3	8.0

The adult moth is usually nocturnal in its activities. They are attracted to light, and hundreds may be caught in light traps.

EXTENT OF DAMAGE

Samples of kiawe flowers from Oahu, Molokai, and Hawaii were examined to obtain an estimate of the larval damage. The data are presented in table 2.

The racemes examined varied in length from about 2½ to 5 inches and the number of florets from about 250 to 525 per raceme. Damaged florets occurred in all parts of the raceme and the number of damaged florets was not proportional to the total number of florets in a raceme. In some racemes, some florets had already fallen. These were considered as not damaged, inasmuch as observations have shown that damaged florets, although detached from the primary axis of the raceme, hung to the axis by means of silk. Damage counts were made after feeding had stopped. The number of damaged florets per raceme ranged from 2 to 282.

The damage is not presented as percentages since it was impractical to count the total number of florets in a raceme. Instead the index used is the number of damaged florets per inch of raceme. This was derived by obtaining the total number of damaged florets in the sample racemes of a station and dividing it by the total length of the racemes of the sample.

FIG. 1. *Ithome concolorella* (Chambers). A–E, larva: A, frontal aspect of head; B, lateral aspect of head; C, lateral aspect of prothorax and mesothorax; D, lateral aspect of third abdominal segment; E, lateral aspect of eighth, ninth, and tenth abdominal segments. F, G, pupa: F, ventral aspect; G, dorsal aspect.

TABLE 2. Damage to kiawe flowers by *I. concolorella.*

STATIONS	NO. OF RACEMES	AV. LENGTH OF RACEMES	AV. NO. OF DAMAGED FLORETS PER INCH OF RACEME	RANGE OF DAMAGED FLORETS PER INCH OF RACEME
Barber's Point, Oahu:				
1	25	3.30	23.0	0.7–48.7
2	25	3.90	26.0	6.2–50.7
3	12	4.00	39.9	12.4–70.5
4	12	3.58	30.7	21.0–50.8
5	9	3.19	26.5	7.1–46.7
E. Molokai	25	3.85	26.5	0.9–58.7
Kawaihae, Hawaii	5	3.45	6.9	1.9–12.0

The number of florets in a sample of 13 racemes from one locality (St. Louis Heights, Honolulu) was obtained, and it was found that there was an average of 100 florets per inch of raceme. If this average is used, the damage indices in table 2, columns four and five, can be read directly as percentages. This average may not be as reliable as desired; however, its use makes it possible to obtain a percentage estimate of the damage done by the larvae. Thus, the most heavily infested station shown in table 2 is Barber's Point (Oahu) 3 where about 40 per cent of the florets was damaged. Consequently 40 per cent of the florets was not available to the honeybees as a nectar source. The adult moth may possibly add to this nectar loss by consuming the nectar before the honeybees can collect it. However, although adults have been observed on the florets, it is not known whether they consumed the nectar or not.

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