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Douglass R. Miller

Systematic Entomology Laboratory, Plant Sciences Institute, Agricultural Research Service, USDA

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Identification of the Pink Hibiscus Mealybug,
Maconellicoccus hirsutus (Green)
(Hemiptera: Sternorrhyncha: Pseudococcidae)

Douglass R. Miller

Systematic Entomology Laboratory

Plant Sciences Institute, Agricultural Research Service

USDA, Bldg. 046, BARC-W, Beltsville, MD 20705, U.S.A.

Abstract: The pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green), has spread rapidly in the tropical and subtropical areas of the New World especially throughout the Caribbean Islands, and has recently been discovered in California, Mexico, and Belize. All instars of the pink hibiscus mealybug are described and illustrated to facilitate discovery of infestations. Comparisons with other common pest species are provided for most of the 8 instars, and a table is included that distinguishes the pink hibiscus mealybug from other pest species in the field.

Introduction

In recent years there has been considerable concern that the pink hibiscus mealybug, *Maconellicoccus hirsutus* (Green) (PHM), would be introduced into the continental United States. These concerns were well founded since the species was discovered in Imperial County, in Southern California in August, 1999. It also has been found in Mexico in the area adjoining the California infestation and is reported causing serious damage in Belize (Dale Meyerdirk, APHIS, personal communication, December 1999). The species occurs in nearly all tropical and subtropical regions of the Old World and causes damage to many agriculturally important crops such as grapes, cotton, and guava and is a serious pest of ornamentals, especially hibiscus. The species was first recorded from the New World in Hawaii in 1983 (Beardsley 1985), and it was verified as occurring outside of Hawaii in 1994 when it was discovered in Grenada (Williams 1996). Since that time, it has expanded its range rapidly throughout the Caribbean and now is in Belize, Mexico, and southern California. The species was considered to be a serious enough threat that a special program was developed in the U. S. Department of Agriculture, Animal and Plant Health Inspection Service to implement effective biological control strategies in the Caribbean countries and to be prepared for action when it became established in the United States. Because of this program, parasites were introduced in California, Mexico, and Belize within a few weeks of the discovery of the mealybug (Meyerdirk, personal communication, December 1999).

The publication by Williams (1996) provided a comprehensive summary of information on the distribution, damage, life history, and systematics of the species, and will not be repeated here. The paper also provided information on the systematics of the genus *Maconellicoccus* and includes a key to the adult females of all 8 included species.

The purpose of this paper is to provide illustrations, brief diagnoses, and a key for the separation of all instars of the pink hibiscus mealybug. A series of tables also is included to help distinguish *M. hirsutus* from other common mealybug pests in the Caribbean area and to separate *M. hirsutus* from other species of *Maconellicoccus*.

A detailed description of each instar of PHM was published by Ghose in 1971. He discovered distinguishing characters for each instar by sex, except for the first instar which apparently cannot be separated by gender morphologically. Unfortunately, the illustrations that were published are so small that little detail can be ascertained. The adult male was described in detail by Afifi (1968). To provide definitive information on the 8 morphologically different instars, I have included illustrations and diagnoses of each instar.

Note that the identity of *Phenacoccus gossypii* Townsend & Cockerell and *P. madeirensis* Green has been confused. The paper by Williams (1987) clarified the identity of the adult females, but no work has been done on the immatures or adult males. Therefore, reference to *P. gossypii* in the tables of comparison could refer either to *P. gossypii* or *P. madeirensis*.

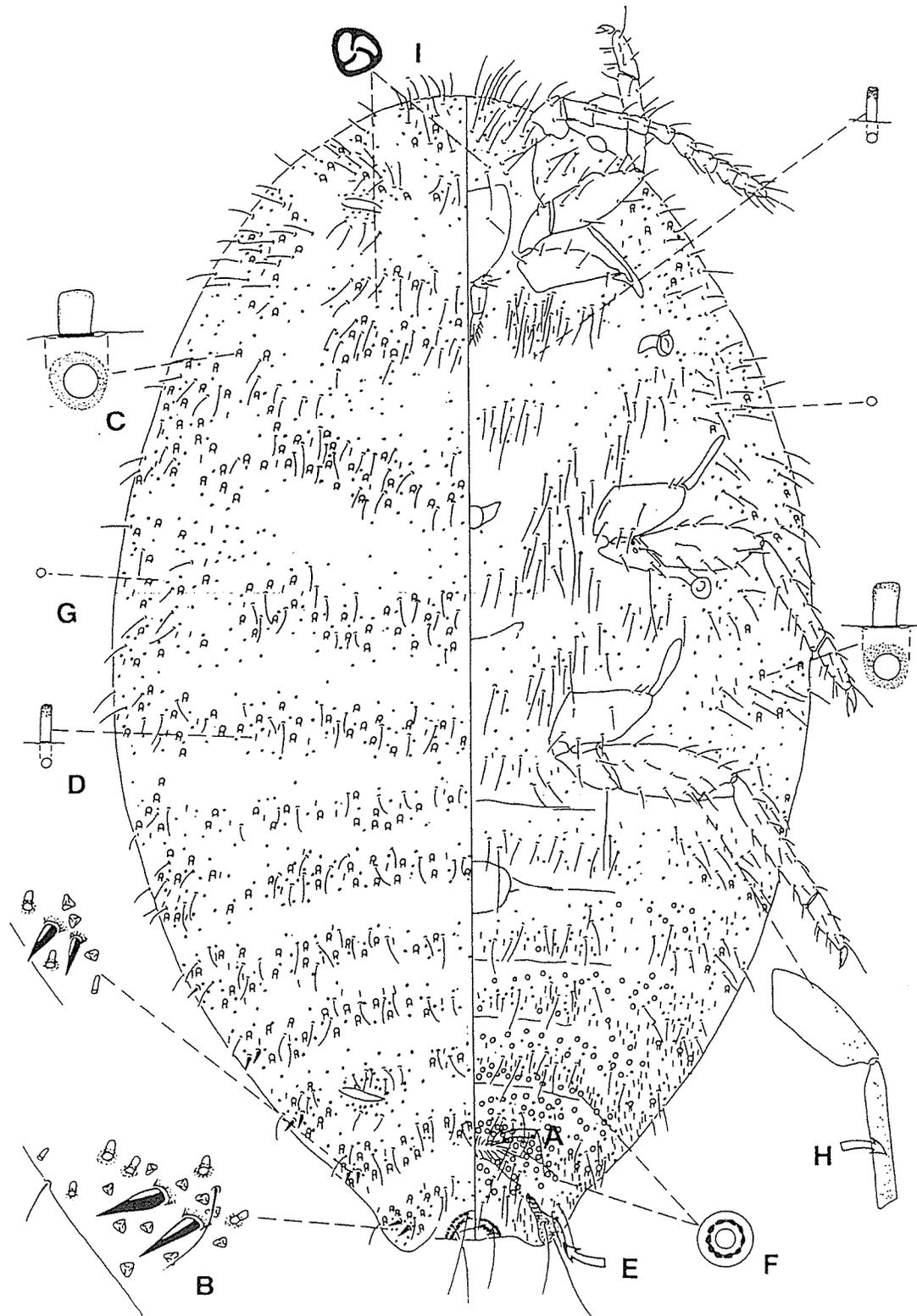


Figure 1. General morphology of adult female of *M. hirsutus* (Green), pink hibiscus mealybug. A - Vulva; B - Cerarius; C - Oral rim; D - Oral collar; E - Anal bar; F - Multilocular pore; G - Discoidal pore; H - Translucent pore; I - Trilocular pore.

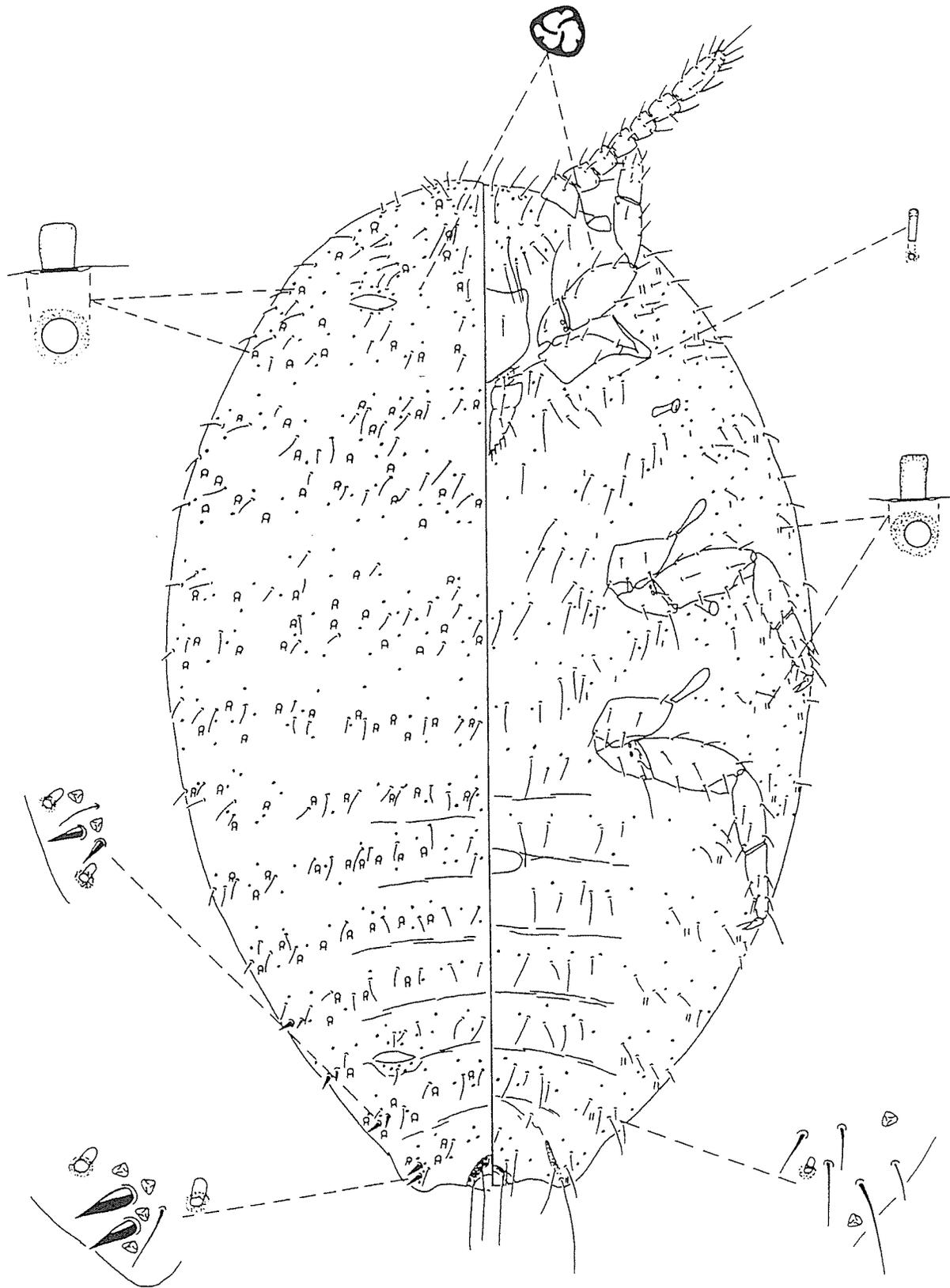


Figure 2. Third-instar female of *M. hirsutus* (Green), pink hibiscus mealybug.

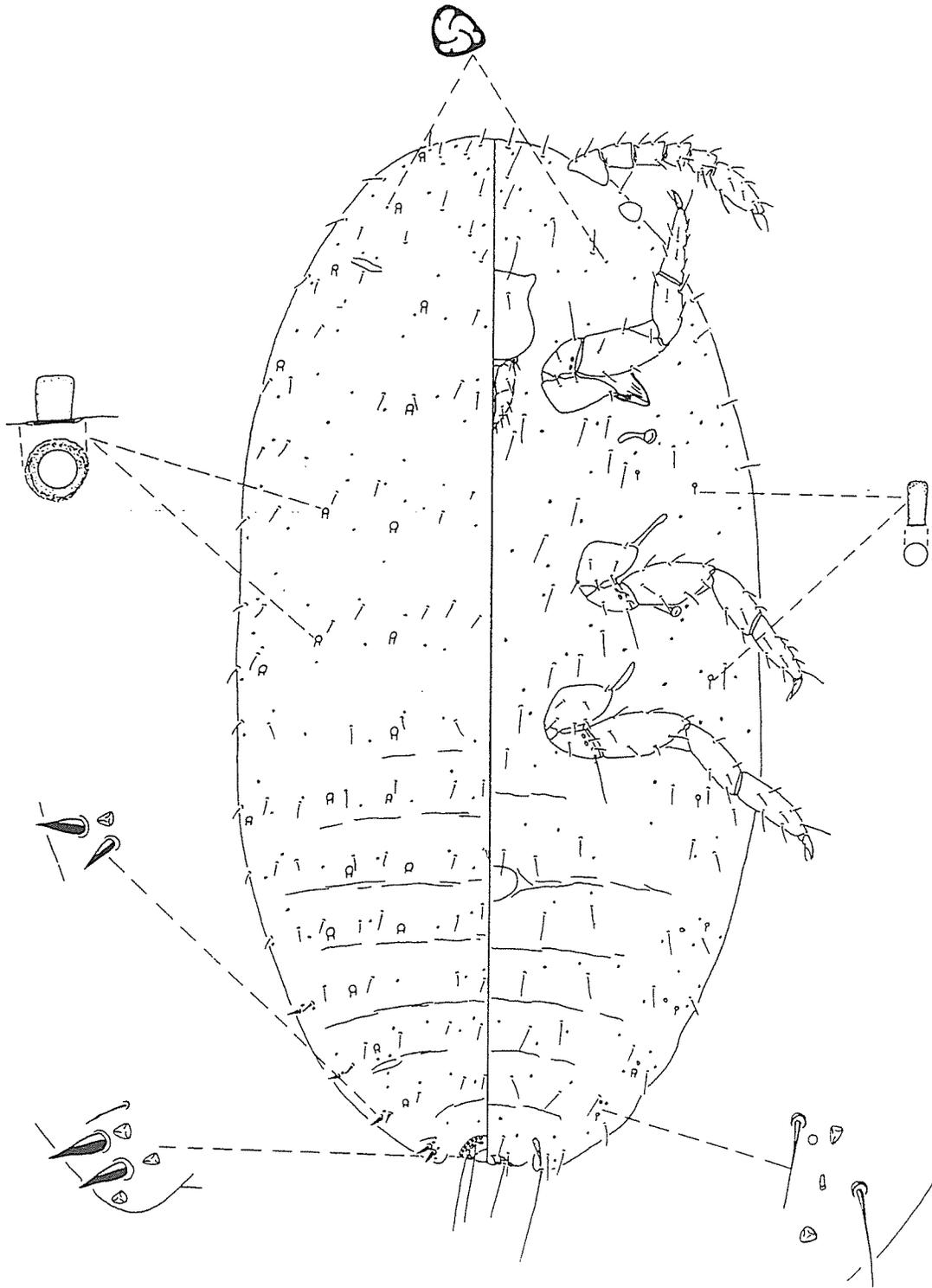


Figure 3. Second-instar female of *M. hirsutus* (Green), pink hibiscus mealybug.

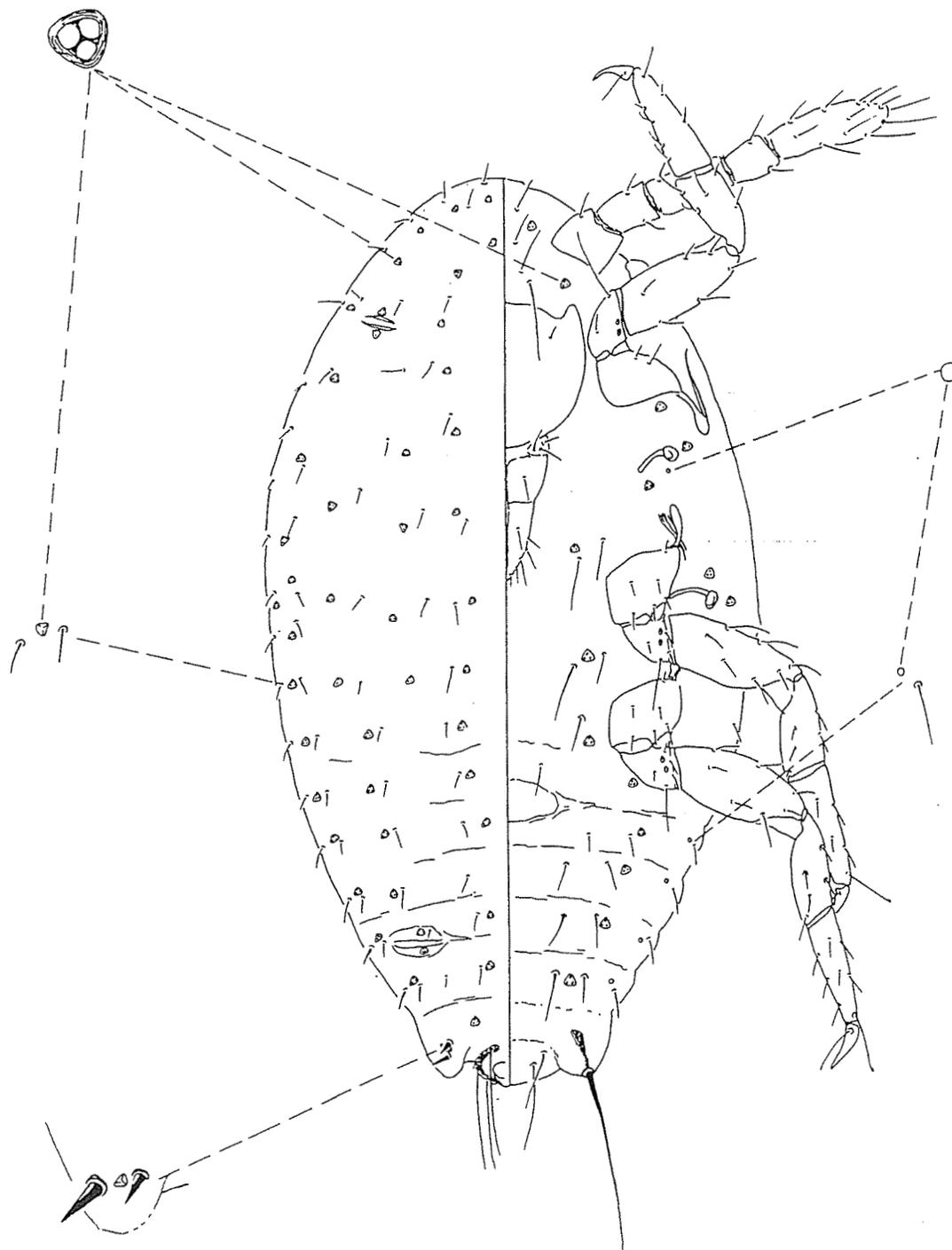


Figure 4. First instar of *M. hirsutus* (Green), pink hibiscus mealybug.

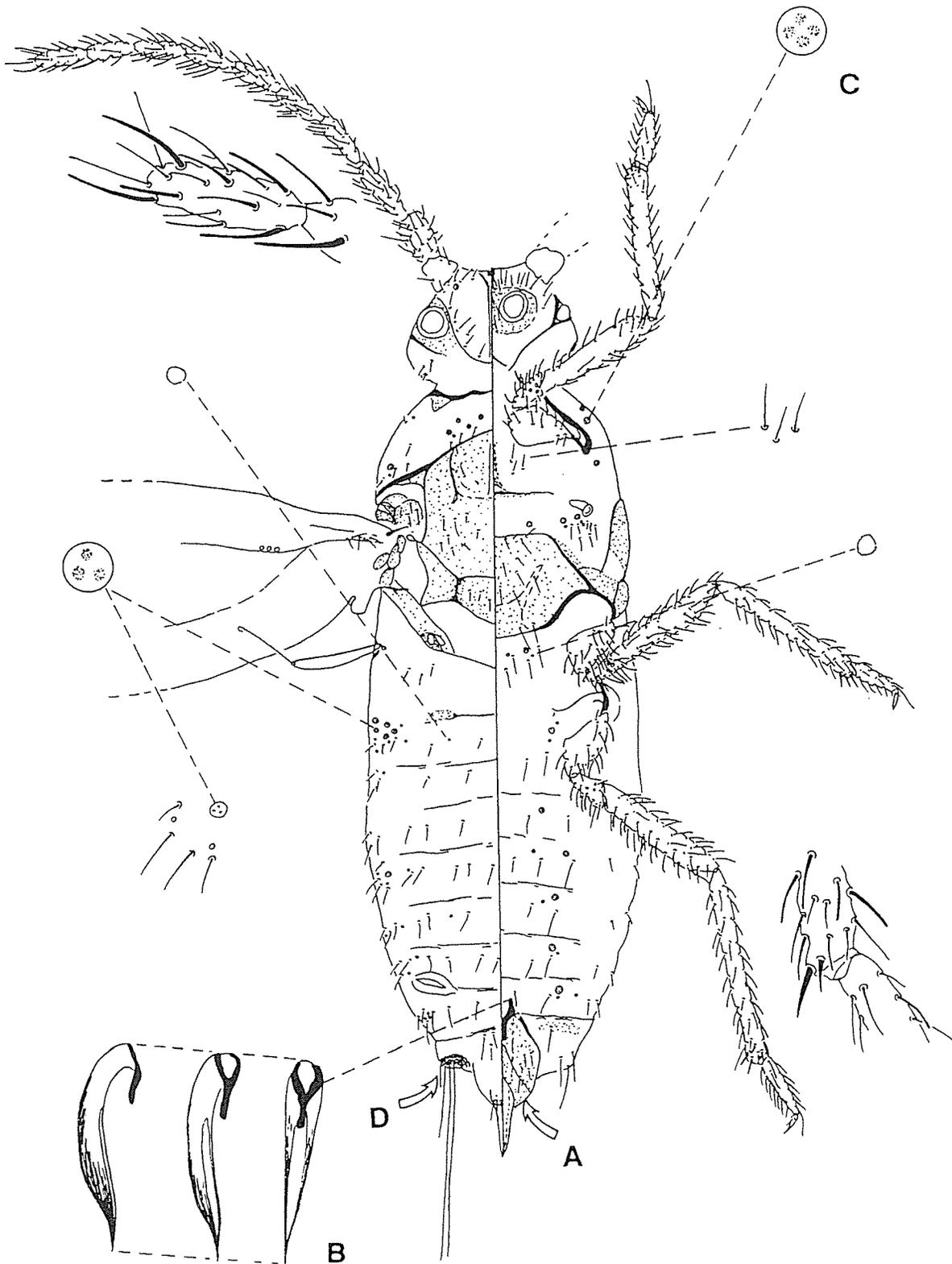


Figure 5. Fifth-instar male (adult) of *M. hirsutus* (Green), pink hibiscus mealybug. A - Penial sheath; B - Aedeagus; C - Multilocular pore; D - Tail-forming pore cluster.

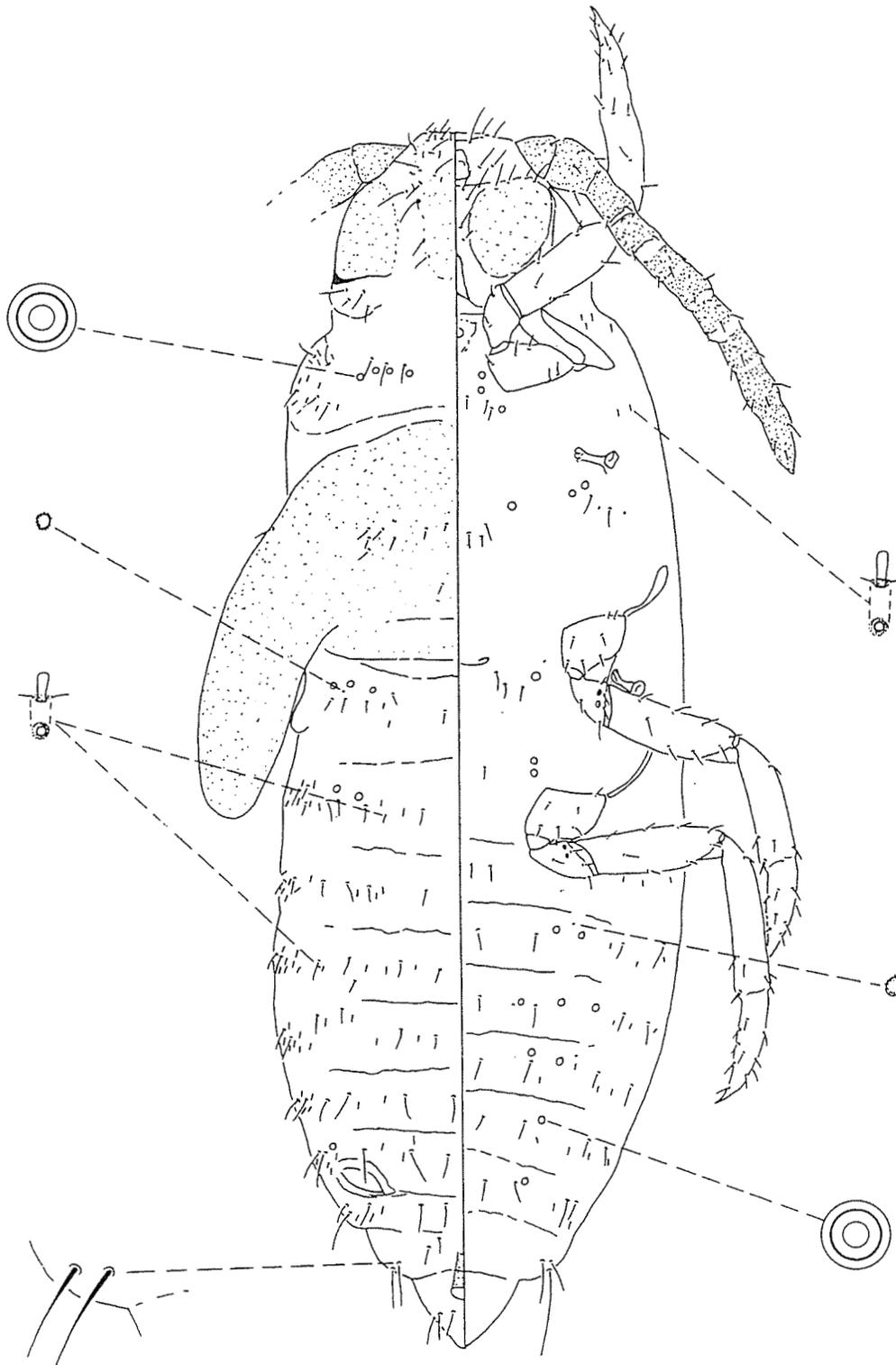


Figure 6. Fourth-instar male (pupa) of *M. hirsutus* (Green), pink hibiscus mealybug. A - Wing buds.

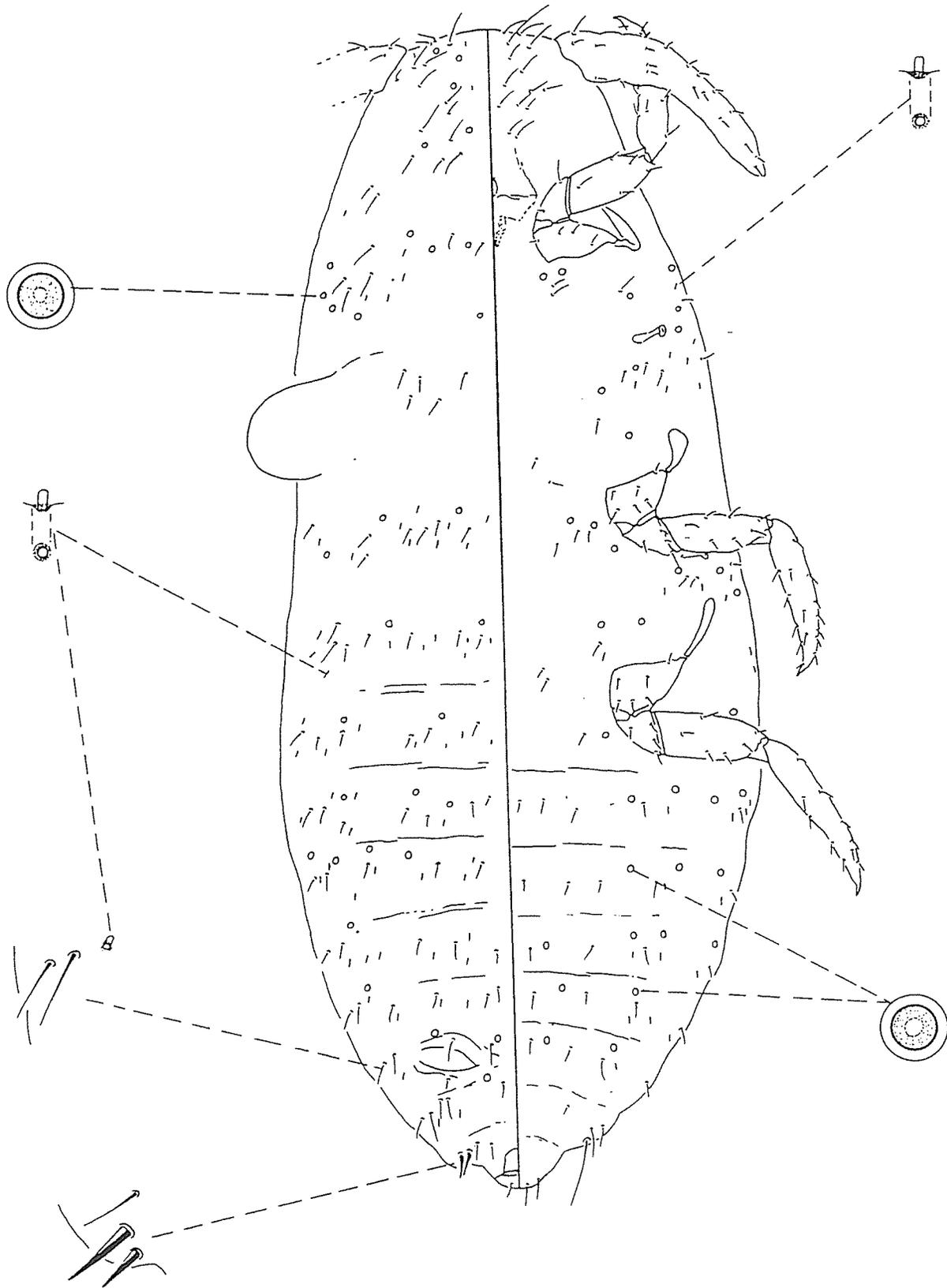


Figure 7. Third-instar male (prepupa) of *M. hirsutus* (Green), pink hibiscus mealybug.

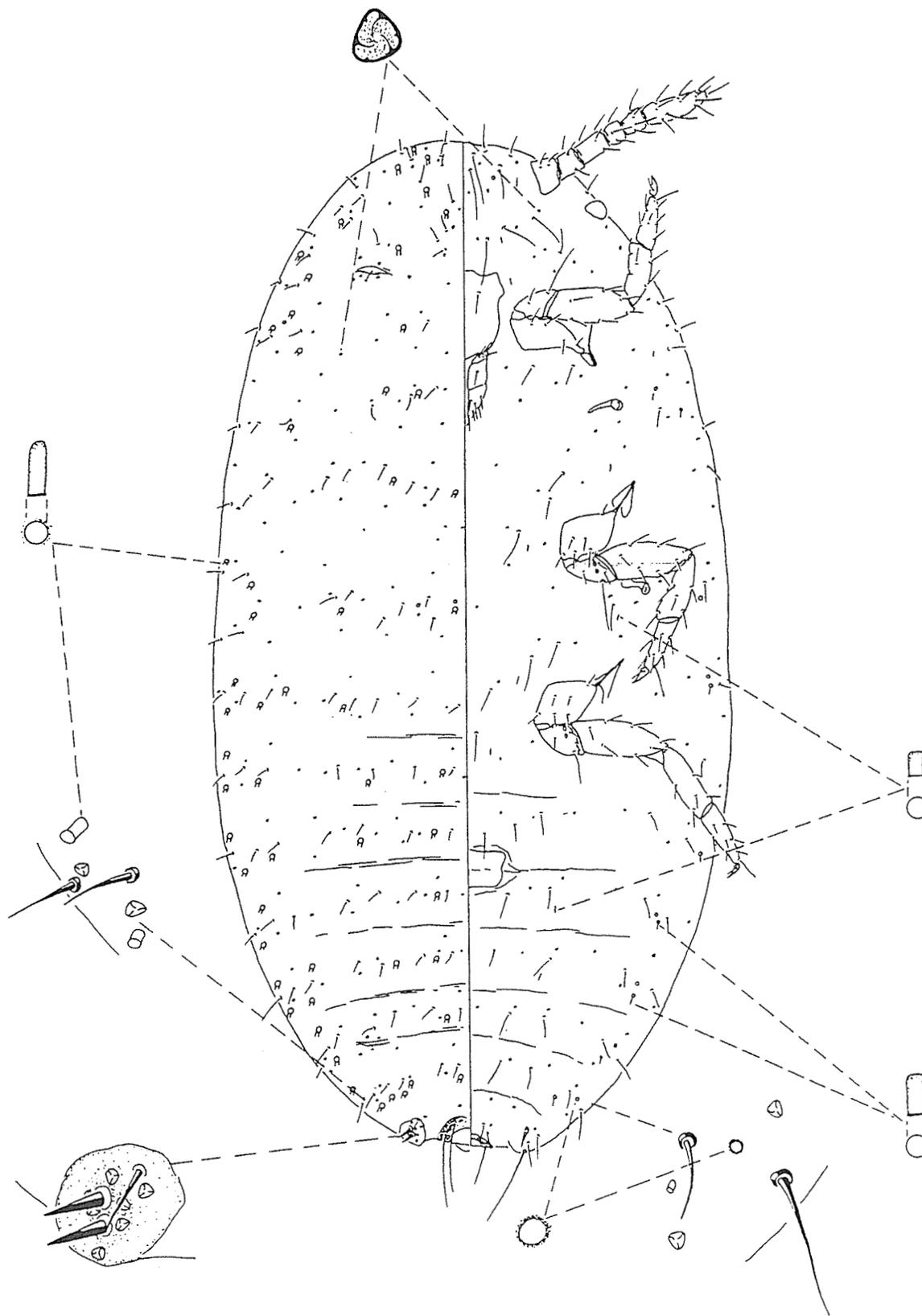


Figure 8. Second-instar male of *M. hirsutus* (Green), pink hibiscus mealybug.

Table 1. Distinguishing characters of various New World pest species using the four female instars. The abbreviated species are: *Maconellicoccus hirsutus*, *Dysmicoccus brevipes* (Cockerell), *Ferrisia virgata* (Cockerell), *Nipaecoccus nipae* (Maskell), *Paracoccus marginatus* Williams and Granara de Willink, *Phenacoccus gossypii* Townsend and Cockerell, *Planococcus citri* (Risso), *Pseudococcus jackbeardsleyi* (Gimpel and Miller), *P. longispinus* (Targioni Tozzetti), *P. viburni* (Signoret), *Puto barberi* (Cockerell). Bold letters signify character states different from *M. hirsutus*.

Common Pest Species	first instar		second-instar female			third-instar female			adult female		
	anal bar	no. cerarii	anal bar	no. cerarii	oral rims	anal bar	no. cerarii	oral rims	anal bar	no. cerarii	oral rims
<i>Macon. hirsutus</i>	yes	1-2	yes	3-4	yes	yes	3-4	yes	yes	4-7	yes
<i>Dysmi. brevipes</i>	no	17	no	17	no	no	17	no	no	17	no
<i>Ferrisia. virgata</i>	no	1	no	1	yes	no	1	yes	no	1	yes
<i>Nipaecoc. nipae</i>	yes	17	?	?	?	yes	10+	no	no	10+	no
<i>Par. marginatus</i>	yes	17	yes	17	no	yes	17	no	yes	17	yes
<i>Phena. gossypii</i>	yes	17	yes	17	no	yes	17	no	yes	17	no
<i>Plano. citri</i>	yes	18	yes	18	no	yes	18	no	yes	18	rare
<i>P jackbeardsleyi</i>	no	17	no	17	no	no	17	yes	no	17	yes
<i>P. longispinus</i>	yes	17	yes	17	yes	yes	17	yes	yes	17	yes
<i>P. viburni</i>	no	17	no	17	no	no	17	yes	no	17	yes
<i>Puto barberi</i>	no	17	no	17	no	no	17	no	no	17+	no

Key to instars of Pink Hibiscus Mealybug

1. Without wings or wing buds on thorax 4
With wings or wing buds on thorax 2
- 2(1). Genitalia weakly sclerotized, aedeagus absent; wings represented by buds less than ½ length of body, without veins 3
Genitalia heavily sclerotized, aedeagus apparent; wings approximately as long as body, with small basal vein adult male
- 3(2). Antenna unsegmented; wing buds small, less than length of thorax; head without sclerotization ...
..... prepupal male
Antenna with 10 segments; wing buds large, about same length as thorax; head with weak sclerotization pupal male
- 4(1). Antennae 6-segmented 5
Antennae 7- or 9-segmented 7
- 5(4). With tubular ducts particularly on dorsal abdomen 6
Without tubular ducts first instar
- 6(5). Cerarii present on last 3 or 4 abdominal segments; tibia slightly shorter than tarsus; body margin of dorsum without clusters of tubular ducts
..... second-instar female
Cerarii present on last 1 or 2 abdominal segments; tibia longer than tarsus; body margin of dorsum with clusters of tubular ducts
..... second-instar male
- 7(4). Antenna 7-segmented; without multilocular pores; without vulva third-instar female
Antenna 9-segmented; with multilocular pores; with vulva adult female

Diagnoses of instars of pink hibiscus mealybug

Slide-mounted characteristics

Fourth-instar females (adults) have: 9-segmented antennae; 4 or 5 recognizable pairs of cerarii (Fig. 1B); 20 or more trilocular pores (Fig. 1I) on each side of each dorsal abdominal segment; 15 or more trilocular pores on each side of each ventral abdominal segment; discoidal pores (Fig. 1G) scattered over both surfac-

Table 2. Distinguishing characters of the 8 species of *Maconellicoccus* using adult females. The abbreviated species are: *M. australensis* (Green and Lidgett); *M. hirsutus*; *M. lanigerus* (Fuller); *M. leptospermi* Williams; *M. multipori* (Takahashi); *M. ramchensis* Williams; *M. tasmaniae* Williams; *M. ugandae* (Laing). Bold letters signify character states different from *M. hirsutus*.

<i>Maconellicoccus</i> species	Adult Female						
	Circulus	Number of cerarii	Sizes of oral rims	Dorsal oral collars	Setae on hind femur	Important reference	General distribution
<i>australensis</i>	no	1 pair	2 sizes	yes	spinelike	Williams 85	Australia
<i>hirsutus</i>	yes	4-7 pair	1 size	yes	hairlike	Williams 96	wide spread except the New World
<i>lanigerus</i>	yes	1 pair	1 size	yes	spinelike	Williams 85	Australia
<i>leptospermi</i>	no	4 pair	1 size	yes	spinelike	Williams 85	Australia
<i>multipori</i>	no	4 pair	1 size	no	hairlike	Williams 96	India, Nepal, Malaysia, Philippines
<i>ramchensis</i>	yes	4 pair	1 size	no	hairlike	Williams 96	Nepal
<i>tasmaniae</i>	yes	1 pair	1 size	no	hairlike	Williams 85	Tasmania
<i>ugandae</i>	yes	4 pair	2 sizes	no	hairlike	Williams 58	Ghana, Kenya, Uganda

es; 15 or more oral-rim tubular ducts (Fig. 1C) on each side of dorsum of each anterior abdominal segment and thoracic segment; oral-collar tubular ducts (Fig. 1D) abundant on both body surfaces; 10 or more setae on each side of each ventral abdominal segment; 10 or more setae on each side of each dorsal abdominal segment; tibia much longer than tarsus; multilocular pores (Fig. 1F) abundant on venter of abdomen; vulva (Fig. 1A) present; translucent pores (Fig. 1H) on hind tibia and tarsus. Fourth-instar females can be separated from those of other mealybug species by the presence of dorsal oral rims, cerarii that are restricted to the hind 4 to 7 abdominal segments, an anal-lobe bar, and 9-segmented antennae. See Figure 1 for an illustration of a slide-mounted fourth-instar female, Table 1 for comparisons with other pest species, and Table 2 for comparisons with other species of *Maconellicoccus*.

Third-instar females have: 7-segmented antennae; 4 or 5 recognizable pairs of cerarii; 9 or more trilocular pores on each side of each dorsal abdominal segment; 9 or more trilocular pores on each side of each ventral abdominal segment; discoidal pores rare or absent; 10 or more oral-rim tubular ducts on each side of dorsum of each anterior abdominal segment and thoracic segment; oral collars uncommon, most abundant on venter of thorax, absent from dorsum; 7 or more

setae on each side of each dorsal and ventral abdominal segment; tibia slightly longer than tarsus; no multilocular pores; no vulva; no translucent pores on hind tibia and tarsus. Third-instar females can be separated from those of other mealybug species by the presence of dorsal oral rims, cerarii that are restricted to the hind 4 or 5 abdominal segments, and an anal-lobe bar. See Figure 2 for an illustration of a slide-mounted third-instar female and Table 1 for comparisons with other pest species.

Second-instar females have: 6-segmented antennae; 4 or 5 recognizable pairs of cerarii; 5 or 6 longitudinal lines of trilocular pores on each side of dorsum; 4 or 5 longitudinal lines of trilocular pores on each side of venter; 1 marginal longitudinal line of discoidal pores on each side of venter; 3 longitudinal lines of oral-rim tubular ducts on each side of dorsum, these not forming marginal clusters; 1 longitudinal line of oral-collar tubular ducts near body margin of venter; 4 longitudinal lines of setae on each side of ventral abdomen; 6 or 7 longitudinal lines of setae on each side of dorsal abdomen; tarsus slightly longer than tibia. Second-instar females can be separated from those of other mealybug species by the presence of dorsal oral rims, cerarii that are restricted to the hind 4 or 5 abdominal segments, and an anal-lobe bar. See Figure 3 for an illustration of a slide-mounted

Table 3. Distinguishing characters of various New World pest species using the adult male. See legend of Table 1 for full names of abbreviated species. Bold letters signify character states different from *M. hirsutus*.

Common Pest Species	Adult Male (fifth instar)					
	Y-shaped sclerotization	Fleshy setae on abdomen	Lateral clusters of pores on abdomen	Tail-forming clusters	pairs of eyes	capitate setae on antennae
<i>Macon. hirsutus</i>	yes	no	anterior segs. only	1 pair	3	apical seg. only
<i>Dysmi. brevipes</i>	no	yes	anterior segs. only	1 pair	3	apical seg. only
<i>Ferrisia virgata</i>	no	no	small, on all segs.	1 pair	3	apical seg. only
<i>Nipaecoc. nipae</i>	no	no	all segments	1 pair	3	apical seg. only
<i>Par. marginatus</i>	no	no	small, on all segs.	1 pair	3	apical seg. only
<i>Phena. gossypii</i>	no	no	all segments	2 pair	3	absent
<i>Plano. citri</i>	no	no	all segments	1 pair	3	apical seg. only
<i>P. jackbeardsleyi</i>	no	yes	small, on all segs.	1 pair	3	apical seg. only
<i>P. longispinus</i>	no	yes	small, on all segs.	1 pair	3	apical seg. only
<i>P. viburni</i>	no	yes	small, on all segs.	1 pair	3	apical seg. only
<i>Puto barberi</i>	no	no	all segments	1 pair	6 or 7	absent

Table 4. Distinguishing characters of various New World pest species using second-instar male. See legend of Table 1 for full names of abbreviated species. Bold letters signify character states different from *M. hirsutus*.

Common pest species	Second-Instar Male					
	multilocular pores	no. antennal segments	anal-lobe bar	no. cerarii	discoidal pore nr. eye	oral rims
<i>Macon. hirsutus</i>	absent	6	present	1 or 2 pair	absent	usually absent
<i>Dysmi. brevipes</i>	absent	6	absent	17 pair	present	absent
<i>Ferrisia virgata</i>	absent	6	absent	1 pair	absent	absent
<i>Nipaecoc. nipae</i>	present	6	present?	10+ pair	present	present
<i>Par. marginatus</i>	present	6	present	10+ pair	absent	absent
<i>Phena. gossypii</i>	absent	6	present	10+ pair	absent	absent
<i>Plano. citri</i>	present	6	present	10+ pair	absent	absent
<i>P. jackbeardsleyi</i>	absent	6	absent	17 pair	present	absent
<i>P. longispinus</i>	absent	6	present	17 pair	absent	absent
<i>P. viburni</i>	absent	6	absent	17 pair	present	absent
<i>Puto barberi</i>	absent	7 or 8	absent	17 pair	absent	absent

Table 5. Distinguishing characters of various New World pest species using the adult females. See legend of Table 1 for full names of abbreviated species. Bold letters signify character states different from *M. hirsutus*.

Common Pest species	Adult Female					
	No. lateral filaments	Caud. filament length to body length	Body color	Stripes	Ovisac	Other unique characters
<i>Macon. hirsutus</i>	absent, rarely 1 or 2	short	reddish brown to orangish pink	no	covers body	
<i>Dysmi. brevipes</i>	many	1/4 to 1/2	pink	none	none	
<i>Ferrisia virgata</i>	1 pair	1/4 to 1/2	grayish	2	none	crystalline rods on dorsum
<i>Nipaecoc. nipae</i>	many	about 1/4	red	none	none	filaments on dorsum
<i>Par. marginatus</i>	many	less than 1/4	yellow	none	beneath body	Turns black in alcohol
<i>Phen. gossypii</i>	many	less than 1/4	gray	2	covers body	
<i>Phen. solenopsis</i>	many	less than 1/4	green	2	none	large body
<i>Plano. citri</i>	many	less than 1/4	pink	1	beneath body	
<i>P. jackbeardsleyi</i>	many	about 1/2	pink?	none	covers part of body	filaments thin
<i>P. longispinus</i>	many	as long as body	gray	1	none	hind 2 pair of filaments long
<i>P. viburni</i>	many	about 1/2	pink	none	covers part of body	filaments thin
<i>Puto barberi</i>	many	about 1/4	?	2	none	filaments broad; wax thick

second-instar female and Table 1 for comparisons with other pest species.

First instars (sex not determined) have: 6-segmented antennae; 1 or 2 recognizable pairs of cerarii; 3 or 4 longitudinal lines of trilocular pores on each side of dorsum; 1 or 2 longitudinal lines of trilocular pores on each side of venter; 1 marginal longitudinal line of discoidal pores on each side of venter; no oral-rim or oral-collar tubular ducts; 3 longitudinal lines of setae on each side of ventral abdomen; 4 longitudinal lines of setae on each side of dorsal abdomen; tarsus longer than tibia. First instars of PHM differ from the first instars of other

mealybugs by having 1 or 2 pairs of definite cerarii and an anal-lobe bar. See Figure 4 for an illustration of a slide-mounted first instar and Table 1 for comparisons with other pest species.

Fifth-instar males (adults) have: 10-segmented antennae; well-developed legs and wings; 3 pairs of eyes; penial sheath (Fig. 5A) and aedeagus (Fig. 5B); aedeagus with y-shaped basal rod; no fleshy setae on body; numerous fleshy setae on legs and antennae; clusters of multilocular pores (Fig. 5C) on lateral areas of abdomen restricted to tail-forming pore cluster (Fig. 5D) and anterior 1 or 2 abdominal segments. Adult males can be separated from the

males of other mealybug species by the presence of a heavily sclerotized, Y-shaped process at the anterior end of the aedeagus. It also differs from closely related species such as the *Nipaecoccus nipae* (Maskell), *Planococcus citri* (Risso), and *P. minor* (Maskell) by lacking clusters of pores on the lateral areas of each abdominal segment. PHM has a cluster of pores on only 1 or 2 anterior segments, but lacks them on the posterior segments. Males of PHM differ from species of *Pseudococcus* and *Dysmicoccus* by lacking fleshy setae on the body; PHM has hair-like setae on the body. See Figure 5 for an illustration of a slide-mounted fifth-instar male and Table 3 for comparisons with other pest species.

Fourth-instar males (pupae) have: 10-segmented antennae; 2 pair of wing buds; oral-collar tubular ducts scattered over dorsum and venter; multilocular pores present on dorsum and venter, but restricted in distribution; without cerarii; vestigial mouthparts. See Figure 6 for an illustration of a slide-mounted fourth-instar male. Pupae are so poorly known that it is not possible to make useful comparisons with other pest species.

Third-instar males (prepupae) have: antennae with indiscernible segmentation; 1 pair of wing buds; oral-collar tubular ducts scattered over dorsum and venter; multilocular pores abundant over dorsum and venter; 1 pair of cerarii; vestigial mouthparts. See Figure 7 for an illustration of a slide-mounted third-instar male. Prepupae are so poorly known that it is not possible to make useful comparisons with other pest species.

Second-instar males have: 6-segmented antennae; 1 or 2 recognizable pairs of cerarii; at least 6 longitudinal lines of trilocular pores on each side of dorsum; 4 or 5 longitudinal lines of trilocular pores on each side of venter; 1 marginal longitudinal line of discoidal pores on each side of venter; 4 or more longitudinal lines of oral-collar or oral-rim tubular ducts on each side of dorsum, oral collars forming marginal clusters on most body segments (oral rims are usually absent); 1 longitudinal line of oral-collar tubular ducts near body margin of venter and several shorter oral collars in mediolateral line on each side of venter; 4 longitudinal lines of setae on each side of ventral abdomen; 6 or 7 longitudinal lines of setae on each side of dorsal abdomen; tarsus slightly shorter than tibia. Second-instar males can be separated from those of other mealybug species by the presence of cerarii that are restricted to the hind 1

or 2 abdominal segments, and an anal-lobe bar. See Figure 8 for an illustration of a slide-mounted second-instar male and Table 4 for comparisons with other pest species.

Field characteristics

In general it is dangerous and unreliable to make determinations of mealybugs based on their external features. However, with the hope of encouraging individuals to search for this mealybug, some general information is given in Table 5 concerning the external appearance of PHM and other common pests. For positive identification it is important to examine and evaluate the characteristics of slide-mounted specimens.

Fourth-instar females (adults) have: up to 2 or 3 short lateral filaments in the caudal area (normally none are visible); body color is reddish brown to orangish pink; body covered with sparse white wax, but with no stripes or blotches; ovisac is produced over entire body. See Table 5 for comparisons with other pest species.

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