

**REDESCRIPTION OF  
*ARMIGERES (ARMIGERES) THEOBALDI*  
(DIPTERA: CULICIDAE)**

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**ABSTRACT.** The female, male, pupa, and fourth-instar larva of *Armigeres theobaldi* Barraud from Thailand are described and illustrated.

**INTRODUCTION**

Species of the subgenus *Armigeres* are mostly well defined and can be easily identified by male genitalia (Ramalingam 1987). However, many of the early descriptions are extremely brief and inadequate, especially by current standards.

*Armigeres theobaldi* was proposed by Barraud (1934) as a *nomen novum* for *Desvoidea apicalis* Theobald, 1910 based on only a female specimen. Mattingly and Qutubuddin (1952) and Thurman (1959) described the male of this species. Several collections of this species were made in Thailand by the Mosquito Research Project during the years 1981-87. Many adults, immature stages, and associated rearings obtained at Kuntan (about 500 m elevation), northern Thailand, are used for the redescription of this species. The pupa and larva are described and illustrated for the first time. The terminology used for the adult and male genitalia follows Harbach and Knight (1980).

**DESCRIPTION**

**Female** (Fig. 1A,B). Wing about 4.0 mm. Proboscis 2.8 mm. Forefemur about 3.1 mm.

Abdomen about 4.7 mm. Large in size. *Head:* Eyes separated by narrow strip of white scales. Vertex covered with broad dark scales, with a posteromedian patch of broad white scales. Occiput with white erect forked scales. Narrow band of broad white scales along ocular line and lateral ocular area; postgena with broad dark scales; interocular and ocular setae long, yellow to brown. Clypeal integument dark with white scales. Proboscis long, slightly curved, laterally compressed in apical 0.5; uniformly covered by dark scales. Antenna approximately 2.1 mm long; pedicel brown, with fine white scales on inner and lower sides; flagellum pilose; flagellomere 1 with white scales on inner side. *Thorax:* Integument brown to dark brown. Scutum densely covered with narrow curved brown scales with metallic luster. Narrow curved white scales extending laterally from anterior promontory, becoming broader over paratergite and ending at wing root. Scales on prescutellar area coarse, grayish. Acrostichal, dorsocentral, prescutellar, and scutual fossal setae absent. Many conspicuous antealar and supraalar setae present. Scutellum covered with flat white scales, each lateral lobe with 6-10 brown setae. Mesopostnotum bare, integument brown. Anteprenotal lobes of normal size, covered by small white scales, with 4,5 setae, posterior margin with brown scales. Postpronotum covered with small narrow white scales in upper 0.5; lower 0.5 and posterior border with broad white scales; row of 5 setae along posterior border. Prespiracular setae absent. Postspiracular area with patch of white scales and 2-4 setae. Paratergite with white scales. Proepisternum covered with flat

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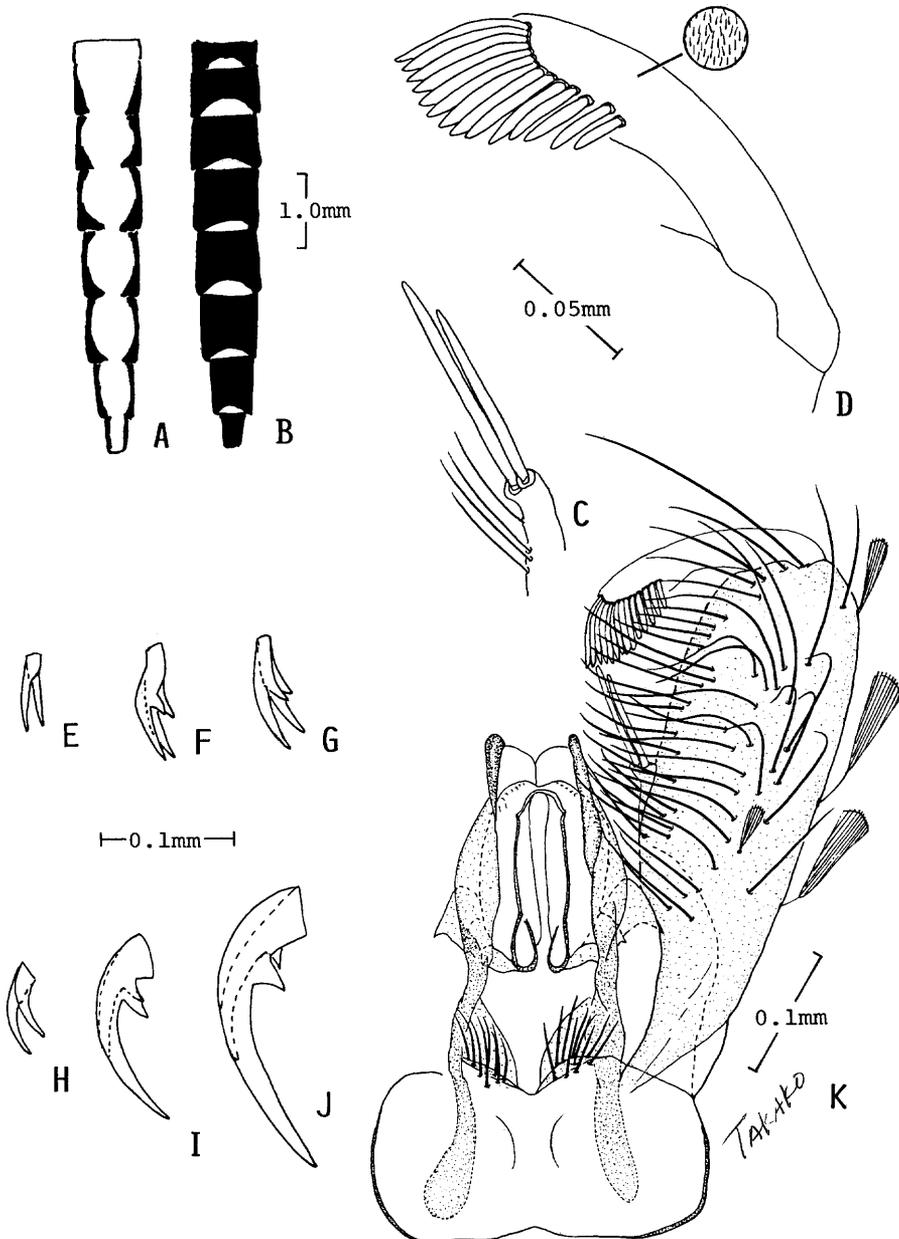
*Armigeres (Armigeres) theobaldi*

Fig. 1. Adult of *Armigeres (Armigeres) theobaldi*. A,B, Abdomen of female, A, ventral aspect, B, dorsal aspect; C,D,K, Male genitalia, C, basal mesal lobe with stout setae, D, gonostylus; E-G, Ungues of female, E, hindungues, F, midungues, G, foreungues; H-J, Ungues of male, H, hindungues, I, midungues, J, foreungues.

white scales, with about 10 setae; anepisternal cleft with patch of white scales. Mesokatepisternum with large patch of white scales and row of setae on posterior border; lower

mesokatepisternum with patch of white scales and several setae; prealar knob with broad white scales and several setae. Mesanepimeron with large patch of broad white scales

and many upper setae. Mesomeron and metepisternum bare. *Legs*: All coxae covered with white scales, with a row of several setae on anterior and posterior sides; scales and setae absent on posterior side of midcoxa. All femora with dorsal knee-spots; fore- and midfemora entirely white except dorsal surface black; hindfemur entirely white except dorsoposterior surface black. All tibiae black except ventral surface somewhat white. Tarsi entirely dark-scaled. *Ungues* (Fig. 1E-G): Fore- and midungues large, each with tooth of equal size; hindungues smaller, without teeth. *Wing*: Dark-scaled. Cell  $R_2$  about 1.2 length of  $R_{2+3}$ . Anal vein ending well beyond fork of Cu. Alula with row of small scales; upper calypter with row of long hairlike scales. *Halter*: Capitellum dark, remainder light in color. Small brown scales dorsally, white scales basally. *Abdomen*: Tergum I black-scaled with indistinct pale dorsoposterior patch of scales and many marginal and lateral setae; terga II-VII dark-scaled, with broad yellowish dorsoapical patch, but tergum VII with indistinct dorsal pale patch; tergum VIII dark-scaled. Sternum I entirely white-scaled; sternum II white-scaled except apical corner black; sterna III-VIII white-scaled except for black lateral margin and apical and basal corners (Fig. 1A,B).

**Male.** Wing about 3.6 mm. Proboscis about 2.6 mm. Maxillary palpus about 2.7 mm. Forefemur about 2.7 mm. Resembles female except in the following characters. *Head*: Vertex covered with broad white scales. Antennae about 1.9 mm long, first 10 flagellomeres strongly plumose, last 3 much elongated and annulated. Palpus approximately same length as proboscis. *Thorax*: Prescutellar area with large pale scale-patch. Postpronotum with numerous narrow pale scales on upper 0.5; paratergite entirely covered with white scales. *Legs*: Mid- and hindfemora without distinct knee-spots. *Ungues* (Fig. 1H-J): Foreungues much larger than those of female, about twice size of unguis of other legs; both with blunt tooth at base. Midungues larger than those of hindleg, smaller than those of foreleg; different in size, each with a blunt tooth at base. *Abdomen*: Sternum VIII with

small patch of white scales and many conspicuous setae on apical margin.

**Male genitalia** (Fig. 1C,D,K). Tergum IX with apical area partly sclerotized and divided into 2 lobes by shallow V-shaped depression, 8-12 fine setae on each lobe. Sternum IX broad and membranous with only lateral borders sclerotized, central area with 1-4 fine, elongate setae. Gonocoxite about 3.4 times as long as its width at center; well separated from its mate basally; lateral and ventral aspects with many long setae and scales; dorsal aspect with short fine setae. Basal mesal lobe usually with 2 (occasionally 1-4) stout sharp setae of different sizes, several small setae also present. Gonostylus about 0.36 length of gonocoxite, not reaching base of stout setae on basal mesal lobe. Outer margin of gonostylus slightly convex, bearing fine spicules; comb of 11-14 spiniforms of uniform size, these pigmented, stout, blunt-tipped, closely spaced, arranged in row in apical 0.33. Phallosome oval, without conspicuous teeth. Paraproct sclerotized, well developed.

**Pupa** (Fig. 2A-C). Abdomen 4.7-6.0 mm. Trumpet 0.48-0.63 mm. Paddle 0.66-0.79 mm. Integument yellow to light brown. Chaetotaxy as in Table 1. *Cephalothorax*: Yellow to light brown. *Trumpet*: With brown pigmentation, index 2.4-3.1. *Abdomen*: All segments with very fine spicules. *Paddle*: Lightly pigmented, with fine spicules and long fringe, midrib present. Male genital lobe extending to about 0.68-0.75 of paddle, female genital lobe extending to 0.4-0.45 of paddle.

**Larva** (Fig. 3A-F). Head width 1.01-1.12 mm. Siphon 0.53-0.62 mm. Saddle 0.40-0.51 mm. Chaetotaxy as in Table 2. Setae yellow to light brown, none stellate. Ventral patch of fine spicules present on segments II-VIII. *Head*: Width about 1.1-1.2 length. Light yellowish-brown in color except area around mouth and collar, which are slightly darker. Collar well marked. Dorsomentum dark brown, with strong median tooth and 9-11 teeth on each side. *Antenna*: Length about 0.22-0.27 of head; shaft slightly narrower apically. Integument smooth, yellow. Seta 1-A 0.38-0.52 from base. *Thorax*: Long and prominent pleural setae with barbs. Setae

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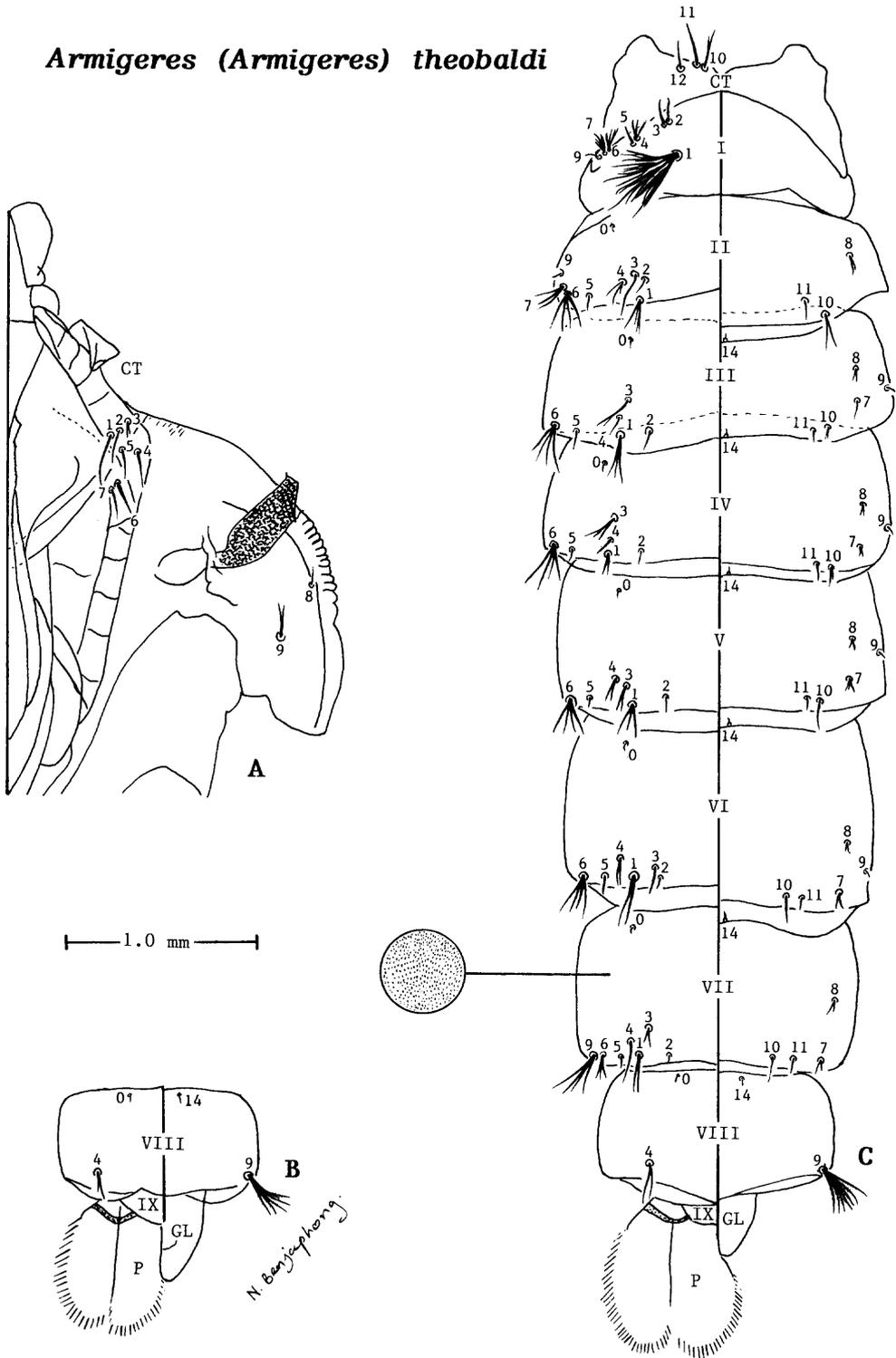


Fig. 2. Pupa of *Armigeres (Armigeres) theobaldi*. A, Cephalothorax; B, Terminal part of abdomen of male; C, Metanotum and abdomen of female.

**Table 1.** Chaetotaxy of the pupa of *Armigeres (Armigeres) theobaldi*.

| Seta no. | Cephalo-<br>thorax |                  | Abdominal segments |        |        |        |        |                  |                  |   |
|----------|--------------------|------------------|--------------------|--------|--------|--------|--------|------------------|------------------|---|
|          | CT                 | I                | II                 | III    | IV     | V      | VI     | VII              | VIII             |   |
| 0        | —                  | —                | 1                  | 1      | 1      | 1      | 1      | 1                | 1                | 1 |
| 1        | 1,2                | M <sup>1,2</sup> | 1-6                | 2-5    | 1-4    | 1-5    | 1-4    | 1-5              | —                | — |
| 2        | 1-3                | 1,2              | 1-3(1)             | 1      | 1      | 1      | 1,2(1) | 1                | —                | — |
| 3        | 1-3                | 1-3              | 1-3                | 1-5    | 1-5    | 1-3    | 1,2    | 1-3              | —                | — |
| 4        | 1-3                | 1-5              | 1-4                | 1,2    | 1,2    | 1-3    | 1-3    | 1-3              | 1-4              | — |
| 5        | 1-6                | 1,2(1)           | 1-3                | 1-3    | 1,2(1) | 1,2(1) | 1,2(1) | 1,2              | —                | — |
| 6        | 1                  | 1-5              | 3-8                | 3-6    | 2-5    | 1-5    | 2-8    | 1-4              | —                | — |
| 7        | 1,2                | 1-5              | 1-4                | 1-3    | 1-3    | 1-5    | 1-5    | 1-3              | —                | — |
| 8        | 1,2                | 3,4 <sup>3</sup> | 2-4                | 1-4    | 1-3    | 1-3    | 1-3    | 1-5              | —                | — |
| 9        | 1-3                | 1                | 1                  | 1,2(1) | 1,2(1) | 1      | 1      | 2-6 <sup>2</sup> | 4-8 <sup>2</sup> | — |
| 10       | 1-4                | 1-5 <sup>4</sup> | 1-3                | 1-3    | 1-3    | 1-3    | 1      | 1                | —                | — |
| 11       | 1-3(1)             | —                | 1,2                | 1      | 1      | 1      | 1,2(1) | 1                | —                | — |
| 12       | 1-3                | —                | —                  | —      | —      | —      | —      | —                | —                | — |
| 14       | —                  | —                | —                  | 1      | 1      | 1      | 1      | 1                | 1,2              | — |

<sup>1</sup> M = multiple branched.

<sup>2</sup> Prominent seta.

<sup>3</sup> Usually absent.

<sup>4</sup> Present on one or both sides; sometimes completely absent.

9-12-P, M, T arise from common tubercle. *Abdomen*: Comb with 4-11 scales in 2 irregular rows, lightly pigmented with stout sharp central tooth and marginal fringe on basal half. *Siphon*: Short, index 1.8-2.0, brown; pecten absent; seta 1-S single, conspicuous, arising about 0.45-0.56 from base. *Segment X*: Saddle incomplete, brown. Anal papillae short, with bluntly rounded apices. Seta 1-X with 2, 2-X with 2-3, 3-X with 2, 4a-X with 1-3, 4b-X with 2, 4c-X with 2-3, 4d-X with 2-4, and 4e-X with 3-5 branches.

**Specimens examined.** Four males, 7 females, 10 larvae, and 10 pupae collected from flower bracts of *Zingiber* and *Curcuma* on Kuntan Mountain, between Lamphum and Lampang, northern Thailand, on November 14-22, 1983, by T. Toma and I. Miyagi.

**Taxonomic discussion.** The adults of *Ar. theobaldi* can be distinguished from all other species of the subgenus *Armigeres* by the following characters: terga I-VII with distinct yellowish-white dorsoapical patch and sterna I-VIII entirely white-scaled except for lateral margin and apical and basal corners; clypeus with white scales; basal mesal lobe of gonocoxite of male with stout sharp setae of 2

different sizes; gonostylus short, with comb of 11-14 spiniforms inserted apically, gradually tapering toward base. As the larvae and pupae of most Asian species of the subgenus are still inadequately described, it is difficult to discuss the characteristic features of *Ar. theobaldi*. However, the larva may be characterized by the following: seta 7-P,M single, short, 7-T double, long; seta 6-II single or double, 6-III-VII single, long; 7-I 2-4 branched, fine, 7-II-VII branched, very fine; comb with 4-11 scales in 2 irregular rows, with stout sharp central tooth and marginal fringe on basal half; seta 1-S single.

**Distribution.** Reported from India, Myanmar, Thailand, and China (Knight and Stone 1977, Lu et al. 1988).

**Biology.** The plant genera *Curcuma* and *Zingiber* (Zingiberaceae) are commonly found in the forest at Kuntan, northern Thailand. These plants produce a vertical inflorescence, mainly in the rainy season. The inflorescence accumulates a considerable amount of water and provides a unique habitat for *Ar. theobaldi*. The habitat and the animal fauna associated with *Curcuma* inflorescence, as well as the population regulation of *Ar. theobaldi*,

*Armigeres (Armigeres) theobaldi*

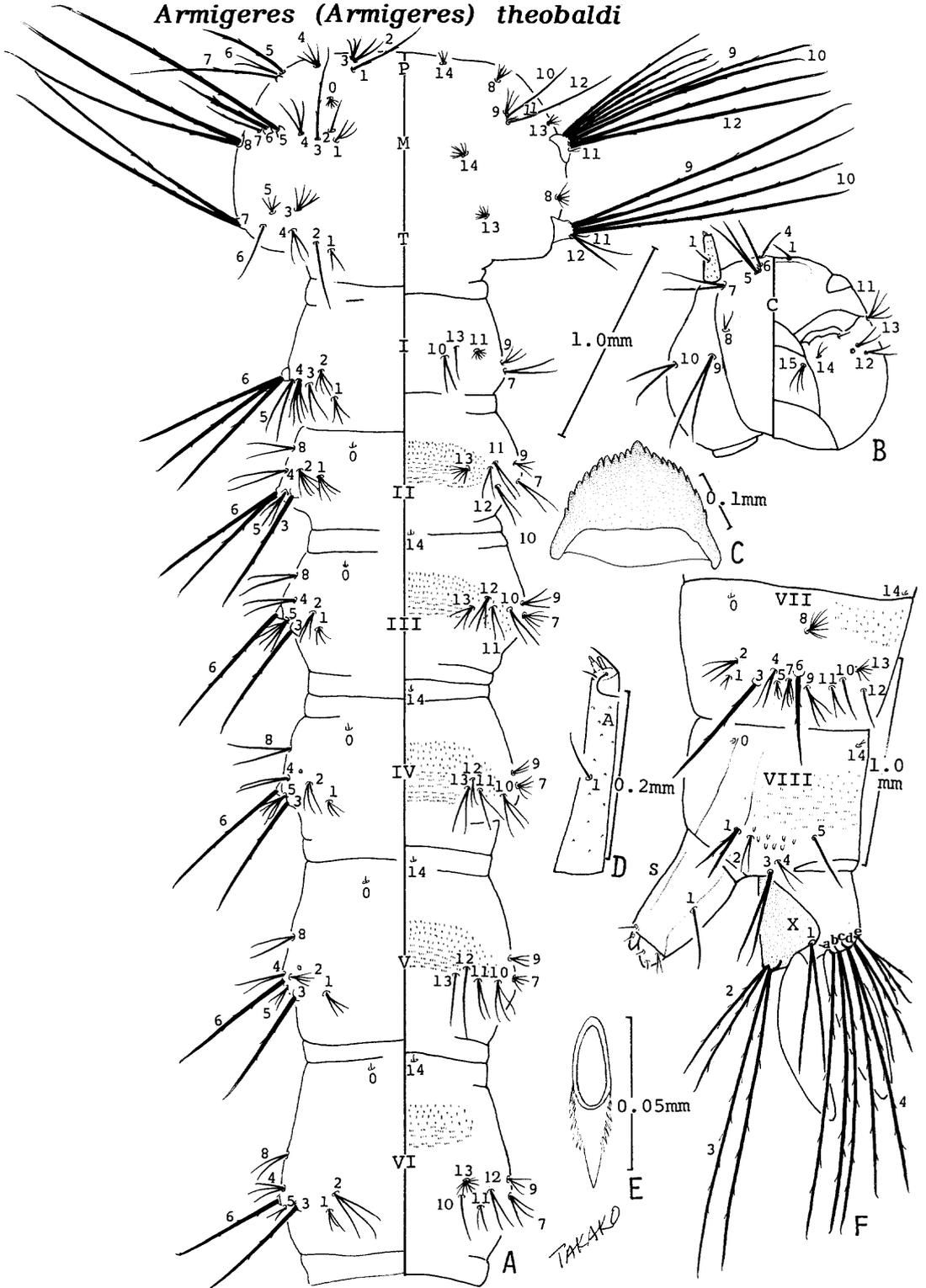


Fig. 3. Larva of *Armigeres (Armigeres) theobaldi*. A, Thorax and abdomen; B, Head; C, Dorsomentum; D, Antenna; E, Comb scale; F, Terminal abdominal segments.

**Table 2.** Chaetotaxy of the fourth-instar larva of *Armigeres (Armigeres) theobaldi*.

| Seta no. | Head   |     |                     | Abdominal segments |                  |                     |        |        |        |        |      |                       |  |  |  |
|----------|--------|-----|---------------------|--------------------|------------------|---------------------|--------|--------|--------|--------|------|-----------------------|--|--|--|
|          | C      | P   | M                   | T                  | I                | II                  | III    | IV     | V      | VI     | VII  | VIII                  |  |  |  |
| 0        | —      | 4-8 | —                   | —                  | —                | 1                   | 1      | 1      | 1      | 1      | 1    | 1                     |  |  |  |
| 1        | 1      | 1   | 2-4                 | 2-5                | 3-7              | 3-7                 | 2-4    | 2-4    | 3-5    | 2-4    | 2,3  | 2-4 <sup>1</sup>      |  |  |  |
| 2        | —      | 1,2 | 1,2                 | 1                  | 4-8              | 4-8                 | 2-4    | 2-4    | 3-9    | 2-5    | 2-6  | 2,3                   |  |  |  |
| 3        | —      | 2-4 | 1                   | 4-6                | 1-3              | 1-3                 | 1-3    | 1-3    | 1-3    | 1-3    | 1-3  | 2,3 <sup>1</sup> (2)  |  |  |  |
| 4        | 1,2(1) | 2-5 | 2-4                 | 2-4                | 4-7              | 1-3                 | 2-6(2) | 2-5(2) | 1-4    | 2-5    | 2-4  | 2-4                   |  |  |  |
| 5        | 2      | 1-3 | 1-3                 | 3-6                | 2-4              | 2-5                 | 4-7    | 3-5(5) | 2-5    | 2-4    | 3-7  | 1,2(1)                |  |  |  |
| 6        | 1      | 1-3 | 1-3                 | 1                  | 2-4 <sup>1</sup> | 1,2(2) <sup>1</sup> | 1-3    | 1-3    | 1-3    | 1-3    | 1-3  | 1-S 1                 |  |  |  |
| 7        | 2      | 1-3 | 1                   | 2-4                | 2-4              | 2,3(2)              | 4-7    | 4-8    | 4-8    | 3-6    | 4-7  | 1-X 2 <sup>1</sup>    |  |  |  |
| 8        | 1-3(2) | 2-7 | 2-4(2) <sup>1</sup> | 5-12               | —                | 2,3(2)              | 2,3(2) | 2      | 1,2    | 2,3(2) | 7-13 | 2-X 2,3 <sup>1</sup>  |  |  |  |
| 9        | 2      | 2-5 | 4-8 <sup>1</sup>    | 2-4                | 2-4              | 3,4                 | 2-5    | 3-6    | 3-6    | 2-5    | 2,3  | 3-X 2 <sup>1</sup>    |  |  |  |
| 10       | 2-4    | 1   | 2-4                 | 2-4                | 2-4              | 2-5(2,3)            | 1-3    | 2-5    | 2,3    | 2      | 1,2  | 4-Xa 1-3 <sup>1</sup> |  |  |  |
| 11       | 3-6    | 2,3 | 1,2                 | 1                  | 6-12             | 1,2(2)              | 1-3    | 1-3    | 1-3    | 1-3    | 1-3  | 4-Xb 2 <sup>1</sup>   |  |  |  |
| 12       | 1-3    | 1,2 | 2-4                 | 1-4                | —                | 2,3(2)              | 2-4    | 2,3(2) | 1-3(1) | 1,2(1) | 1,2  | 4-Xc 2,3 <sup>1</sup> |  |  |  |
| 13       | 2,3(2) | —   | 4-9                 | 5-11               | 1                | 6-11                | 1-5    | 1-3    | 1      | 8-12   | 4-9  | 4-Xd 2-4 <sup>1</sup> |  |  |  |
| 14       | 1,2    | 1-5 | 5-13                | —                  | —                | —                   | 1      | 1      | 1      | 1,2    | 1,2  | 4-Xe 3-5 <sup>1</sup> |  |  |  |
| 15       | 2-6    | —   | —                   | —                  | —                | —                   | —      | —      | —      | —      | —    | 1-A 1                 |  |  |  |

<sup>1</sup> Prominent seta.

were described by Mogi and Yamamura (1988). Biology of the adults is unknown.

#### ACKNOWLEDGMENTS

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