

**The *Kuwayama ventralis* Group;
Three New Species of Hawaiian
Psyllidae (Homoptera), with Descriptions
of Adults and Immature Stages¹**

GRANT K. UCHIDA² and JOHN W. BEARDSLEY³

ABSTRACT. The *Kuwayama ventralis* group is proposed to include three closely related, island specific psyllids from the endemic Hawaiian tree *Pisonia sandwicensis* Hillebrand. These are *Kuwayama ventralis*, n. sp., *Kuwayama oahuensis*, n. sp. and *Kuwayama lanaiensis*, n. sp. Adults and immature stages of these psyllids are described, and species keys for all stages are provided.

The genus *Kuwayama* Crawford (1911) is a large, poorly understood complex of triozone Psyllidae which contains species from widely scattered localities throughout the world. In Hawaii, *Kuwayama* is represented by six previously described, and an undetermined number of undescribed, endemic species (Zimmerman 1948). Known hosts of Hawaiian *Kuwayama* include *Metrosideros*, *Pisonia* and *Nesoluma*. Two species were described by Caldwell (1940) from Oahu on the endemic Hawaiian tree *Pisonia sandwicensis* Hillebrand. *K. minutura* Caldwell forms shallow pit galls on the upper surface of the leaves, whereas *K. pisonia* Caldwell develops within conspicuous tubular pocket galls that protrude below the underside of the leaves (see Zimmerman 1948, p. 27).

During 1989-90 the senior author (GKU) collected adult and immature psyllids from *Pisonia* on the islands of Kauai, Oahu, and Lanai. Three apparently undescribed island-specific species were found which appear to form a natural species complex within the genus *Kuwayama*. These species, referred to here as the *ventralis* complex, develop on the host leaf under surface without producing galls, and the group does not appear to be closely allied to the known gall formers. The adults and immature stages of the three free-living species are described below.

Holotype and allotype specimens (adults) are deposited in the Bernice P. Bishop Museum. Slide mounted immature stages are in the collection of the senior author.

All measurements cited are in millimeters.

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³Department of Entomology, University of Hawaii, Honolulu, Hawaii 96822.

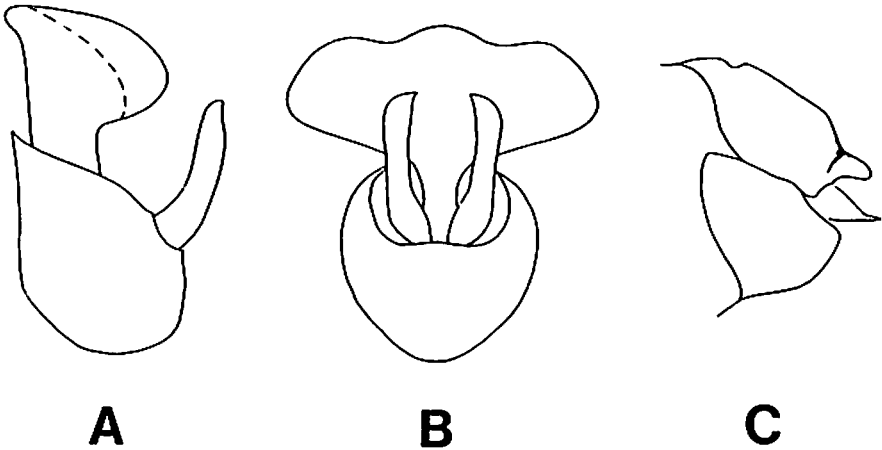


FIGURE 1. *Kuwayama ventralis* genitalia of adult male and female, A, lateral aspect of male terminalia; B, posterior aspect of male terminalia; C, lateral aspect of female ovipositor.

**KEY TO ADULTS OF THE
KUWAYAMA VENTRALIS SPECIES GROUP**

- 1. M vein forks on straight line connecting distal ends of Rs and Cu₁ 2
- M vein forks proximal to straight line connecting distal ends of Rs and Cu₁ *oahuensis*, n. sp.
- 2(1). Prescutum with prominent dark brown medial stripe *ventralis*, n. sp.
- Prescutum without markings *lanaiensis*, n. sp.

**KEY TO IMMATURE STAGES OF THE
KUWAYAMA VENTRALIS SPECIES GROUP**

First Instar

Length 0.36-0.40; width 0.23-0.26.

- 1. Setae near margin of body appear to be present in two rows (Fig. 6) *ventralis*, n. sp.
- Setae near margin of body present in one row 2
- 2(1). Setae with distal portion about 1/2 to 1/3 of entire length (Fig. 2, B) *oahuensis*, n. sp.
- Setae with distal portion about 1/4 of entire length (Fig. 2, C) *lanaiensis*, n. sp.

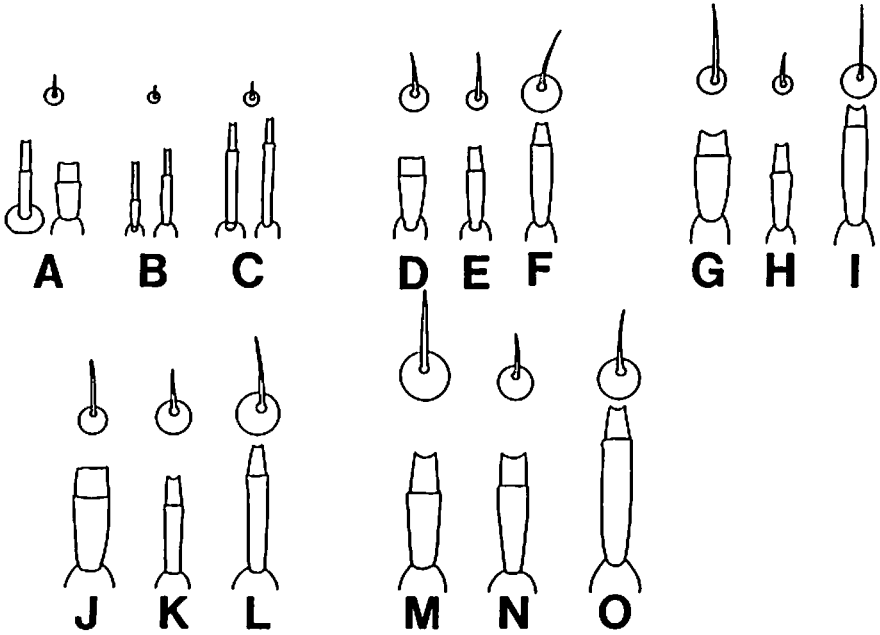


FIGURE 2. *Kuwayama ventralis* species group, nymphal instars, dorsal setae (upper), marginal sectasetae (lower or lower right) and submarginal sectasetae (lower or lower left). A, D, G, J, M, K, *ventralis*; B, E, H, K, N, *K. oahuensis*; C, F, I, L, O, *K. lanaiensis*.

Second, Third, Fourth and Fifth Instars

Second: length 0.52-0.56; width 0.33-0.37.
 Third: length 0.75-0.81; width 0.55-0.64.
 Fourth: length 1.11-1.12; width 0.80-0.82.
 Fifth: length 1.74-2.20; width 1.30-1.70.

- 1. Sectasetae stout, with width (in dorsal view) equal to about 1/3 entire length (Figs. 2, D lower (second instar); G lower (third instar); J lower (fourth instar); M lower (fifth instar)) *ventralis*, n. sp.
- Not as above 2
- 2(1). Sectasetae with distal portion about 1/3 of entire length (Figs. 2, E lower (second instar); H lower (third instar); K lower (fourth instar); N lower (fifth instar)) *oahuensis*, n. sp.
- Sectasetae with distal portion about 1/4 of entire length (Figs. 2, F lower (second instar); I lower (third instar); L lower (fourth instar); O lower (fifth instar)) *lanaiensis*, n. sp.

Relative detailed descriptions of the adult and immature stages of *Kuwayama ventralis*, new species are given below. Descriptions for the two other species in the complex, *K. oahuensis*, n. sp. and *K. lanaiensis*, n. sp.,

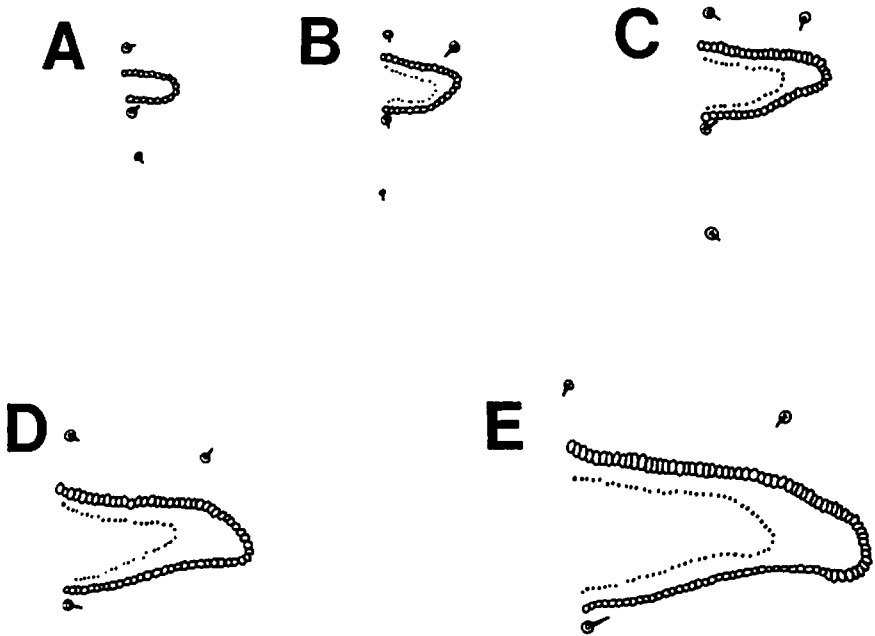


FIGURE 3. *Kuwayama ventralis*, nymphal instars, circumanal pore ring. A, first instar; B, second instar; C, third instar; D, fourth instar; E, fifth instar.

are limited to structures showing useful differences between species, or reference is made to an illustration of the character cited.

Kuwayama ventralis, n. sp. (Figs. 1, A-C; 2, A, D, G, J, M; 3, A-E; 6-10).

Adult. (Fig. 1, A-C).

Diagnosis. Can be distinguished from the two other species of this complex by the presence of brown thoracic and wing markings. Mesothorax with light brown medial stripe; R_1 , $R+M+Cu$ junction brown.

Dimensions. **Male:** length from front of head to tip of wing 3.7; body: length 1.7, width 0.5; anterior wing: length 3.2, width 1.2. **Female:** length from front of head to tip of wing 4.2; body: length 1.7, width 0.7; anterior wing: length 3.6, width 1.3.

Color: General color pale brown. **Head:** markings absent; antennae with terminal segment brown. **Thorax:** pronotum brown along anterior margin; mesothoracic prescutum and scutum with light brown medial stripe. **Wings:** hyaline, radular spines brown, R_1 , $R+M+Cu$ junction dark brown. **Legs:** metacoxae, tibiae and tarsi light brown, tibiae with 2 brown apical spurs. **Abdomen:** brown dorsally, male parameres brown, female proctiger, subgenital plate without markings.

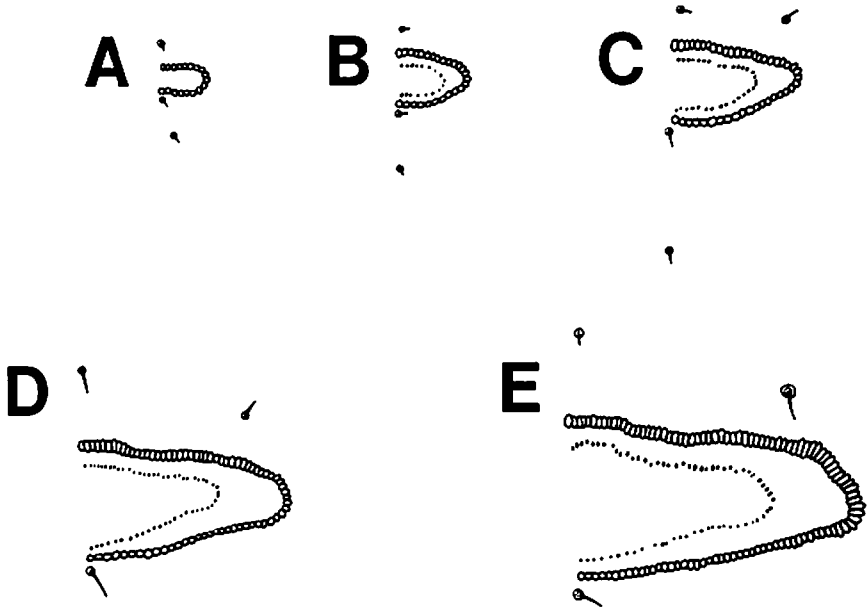


FIGURE 4. *Kuwayama oahuensis*, nymphal instars, circumanal pore ring. A, first instar; B, second instar; C, third instar; D, fourth instar; E, fifth instar.

Structural characters. **Head:** small, positioned below dorsal surface of pre-scutum, declivous; vertex with anterior margin blunt, extending beyond anterior ocellus on each side; depression on each side of vertex midline; genae swollen. **Thorax:** arched, somewhat hispid. **Wings:** anterior wing length little more than 2 × width, M vein forks on straight line connecting distal ends of Rs and Cu₁; posterior wing 3/4 length of anterior wing. **Legs:** metatibia with basal callus, apical spines. **Abdomen:** male, proctiger wing-like in posterior view, parameres arched anteriorly with tip posteriorly curved (Figs. 1, A-B); female, proctiger notched above, with apex nipple like, subgenital plate stout (Fig. 1, C).

Immature Stages.

FIRST INSTAR (Fig. 2, A; 3, A; 6).

Dimensions. Length 0.36-0.40; width 0.24-0.26.

Shape. Elliptical; meso- and metathorax produced laterally.

Margin. Specialized structures absent.

Dorsum. Sclerotization weak; head and thorax fused, divided longitudinally by median groove, cephaloprothorax partially separated from mesothorax by distinct submarginal suture; wingpads absent; abdomen separated from thorax by distinct suture, segments entirely fused. **Indumenta:** sectasetae with emarginate apices, borne on short protuberances in two rows (Fig. 6), with well defined marginal row and poorly defined submarginal row: marginal row consists of relatively stout, moderately dor-

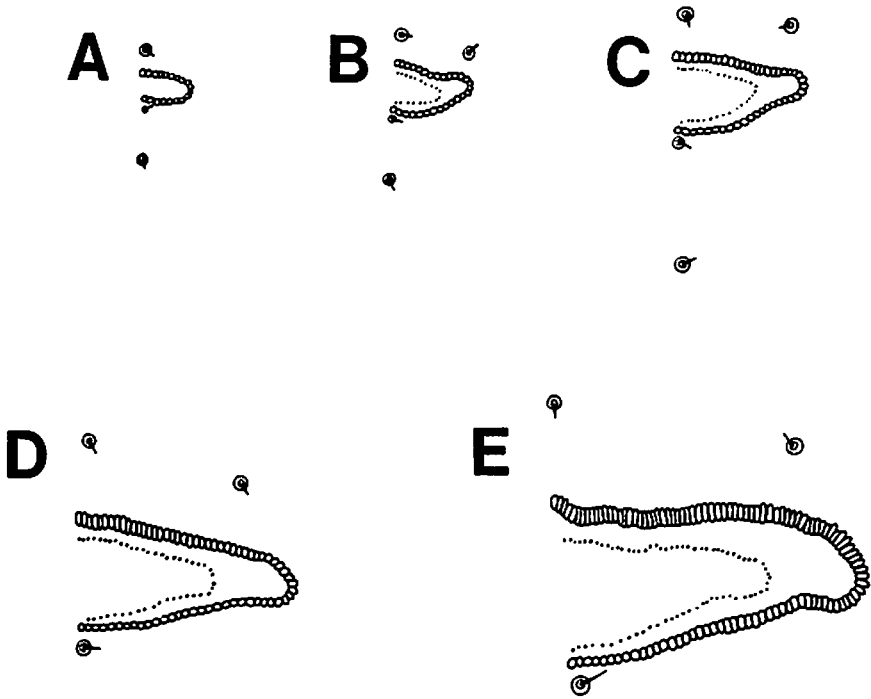


FIGURE 5. *Kuwayama lanaiensis*, nymphal instars, circumanal pore ring. A, first instar; B, second instar; C, third instar; D, fourth instar; E, fifth instar.

soventrally compressed sectasetae (Fig. 2, A lower right), width in dorsoventral view about $\frac{1}{3}$ of entire length, distal portion $\frac{1}{3}$ of entire length; submarginal row consisting of few, elongate sectasetae (Fig. 2, A lower left), width about $\frac{1}{5}$ of entire length, distal portion about $\frac{1}{3}$ of entire length, each side of body with 2 sectasetae on cephaloprothorax, 1 on metathorax, 2 on apex of abdomen. Setae (Fig. 2, A upper) simple, few, small, equal in length. **Cuticular structures:** spinules in transverse band on meso- and metathorax, each abdominal segment. Minute points absent.

Venter: Sclerotization absent except for cuticular structures, circumanal pore ring plate. **Indumenta:** setae simple, sparse, subequal in length; cephaloprothorax with 2 long setae on each side; abdomen with elongate seta on apical segment, anterolateral to circumanal pore ring on each side; circumanal pore ring surrounded by 2 setae on each side (1 anterior, 1 posterior). **Cuticular structures:** spinules in short transverse band across each abdominal segment, alternating with short transverse band of minute points; minute points dense on submarginal region of body. **Antennae:** 1 segmented, short, narrowly triangular; with 4 setae (1 elongate, blunt apical seta, 1 long, subapical seta, 1 subapical specialized seta and 1 long seta near base); with 3 sensoria (2 subapical bearing stout seta-like structures and 1 dorsal near base). **Labium:** basal segment with small seta on each side. **Legs:**

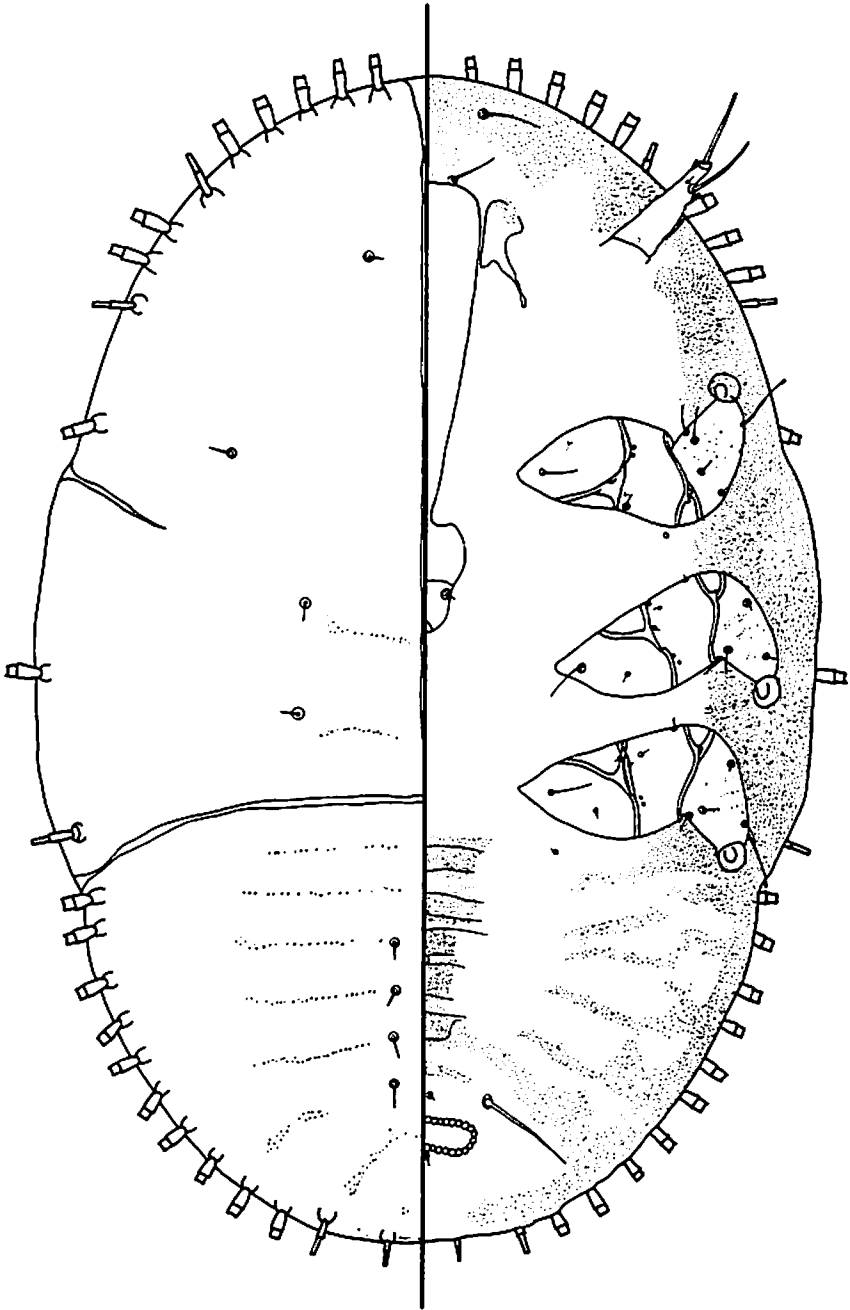


FIGURE 6. *Kuwayama ventralis*, first instar nymph, dorsal and ventral aspects.

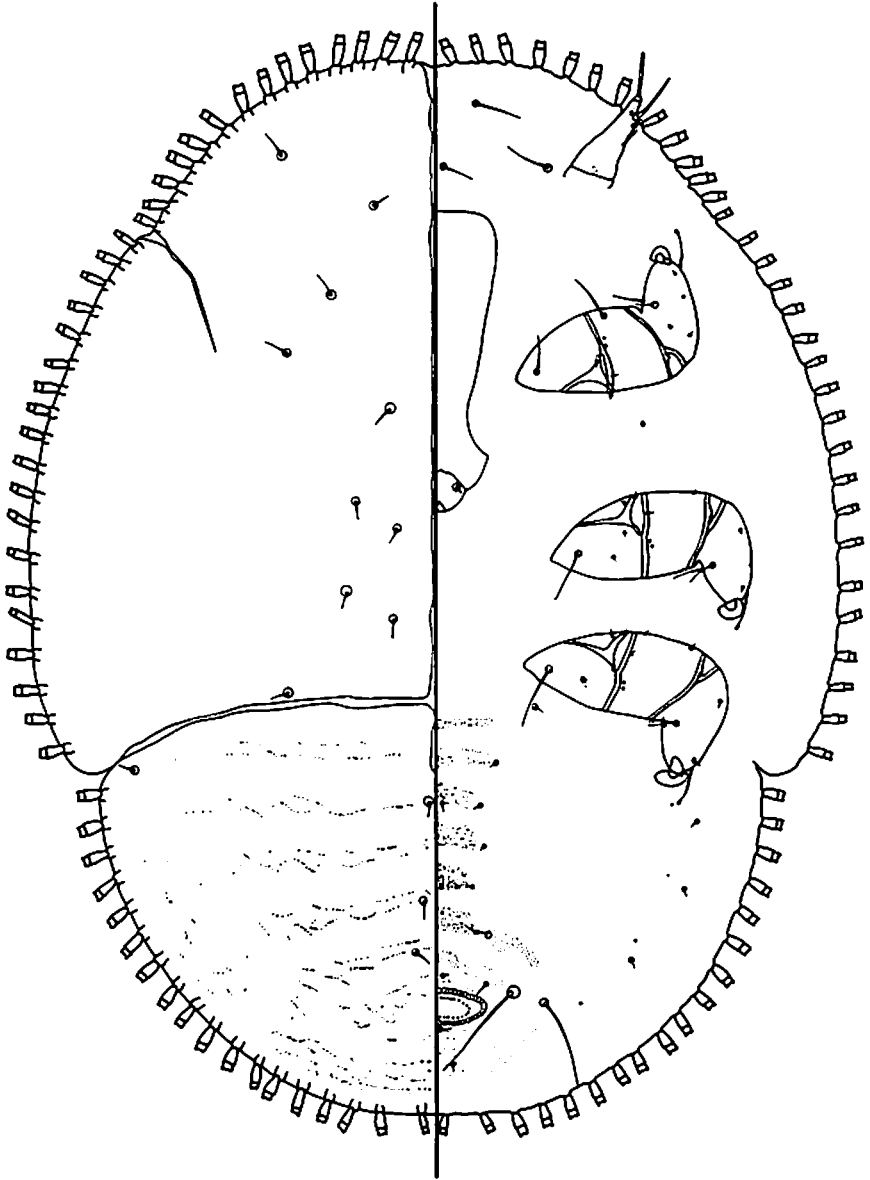


FIGURE 7. *Kuwayama ventralis*, second instar nymph, dorsal and ventral aspects.

relatively stout, trochanter undefined; femora not reaching margin of body; tibiotarsal articulations absent; claws present; pulvillus somewhat elliptical; setae few, simple, subequal in length, long capitate subapical seta on tibiotarsi; spinules sparse; femora with 2 sensoria near base. **Circumanal pore ring** (Fig. 3, A): consisting of single row of circular pores.

SECOND INSTAR (Figs. 2, D; 3, B; 7).

Dimensions. Length 0.52-0.56; width 0.40-0.43.

Shape. Elliptical; cephaloprothorax anteriorly produced on each side; wingpads laterally produced.

Dorsum. Indumenta: sectasetae (Fig. 2, D lower) dorsoventrally compressed, stout, in marginal row on body, apex emarginate, distal portion $\frac{1}{3}$ of entire length. Setae (Fig. 2, D upper) more numerous on head and thorax than in first instar. **Cuticular structures:** spinules absent on meso- and metathorax; in transverse band on each abdominal segment, extending nearly to lateral margin.

Venter. Indumenta: cephaloprothorax with 3 setae on each side; abdomen with seta near each spiracle, 1-2 setae submedially on most abdominal segments, apical segment with 2 elongate setae laterad of circumanal pore ring on each side. **Cuticular structures:** spinules similar in pattern to first instar (not illustrated). **Antennae:** resembling first instar. **Circumanal pore ring** (Fig. 3, B): inner row composed of single row of circular pores.

THIRD INSTAR (Figs. 2, G; 3, C; 8).

Dimensions. Length 0.75-0.84; width 0.61-0.64.

Shape. Posterior wing pads laterally produced; abdominal apex weakly emarginate.

Dorsum. Indumenta: sectasetae (Fig. 2, G lower). Setae (Fig. 2, G upper) many, scattered on head and thorax, with several on abdomen.

Venter. Indumenta: cephaloprothorax with 4 setae on each side; abdomen with 3 longitudinal rows on each side, apical abdominal segment with 3 enlarged setae anterolaterad of circumanal pore ring on each side. **Antennae:** three segmented; basal segment with 1 specialized seta near apex; with 2 sensoria (1 dorsal near base, 1 medial); apical segment with 2 setae (1 blunt apical, 1 long subapical); with 2 subapical sensoria with seta-like structures. **Circumanal pore ring** (Fig. 3, C).

FOURTH INSTAR (Figs. 2, J; 3, D; 9).

Dimensions. Length 1.27-1.31; width 0.98-1.02.

Dorsum. Wingpads defined by sutures. **Indumenta:** sectasetae (Fig. 2, J lower). Setae (Fig. 2, J upper) numerous, scattered over entire dorsum. **Cuticular structures:** spinules scattered over submarginal region of abdomen.

Venter. Antennae: five segmented; basal segment with 2 sensoria (1 dorsal near base, 1 subapical); second segment with 1 subapical sensorium; third segment with 1 subapical specialized seta; apical segment resembling apical segment of third instar except for presence of 2 dorsal and 1 medial sensorium. **Legs:** profemora with 2, mesofemora with 3 and metafemora with 4 sensoria near base. **Circumanal pore ring** (Fig. 3, D).

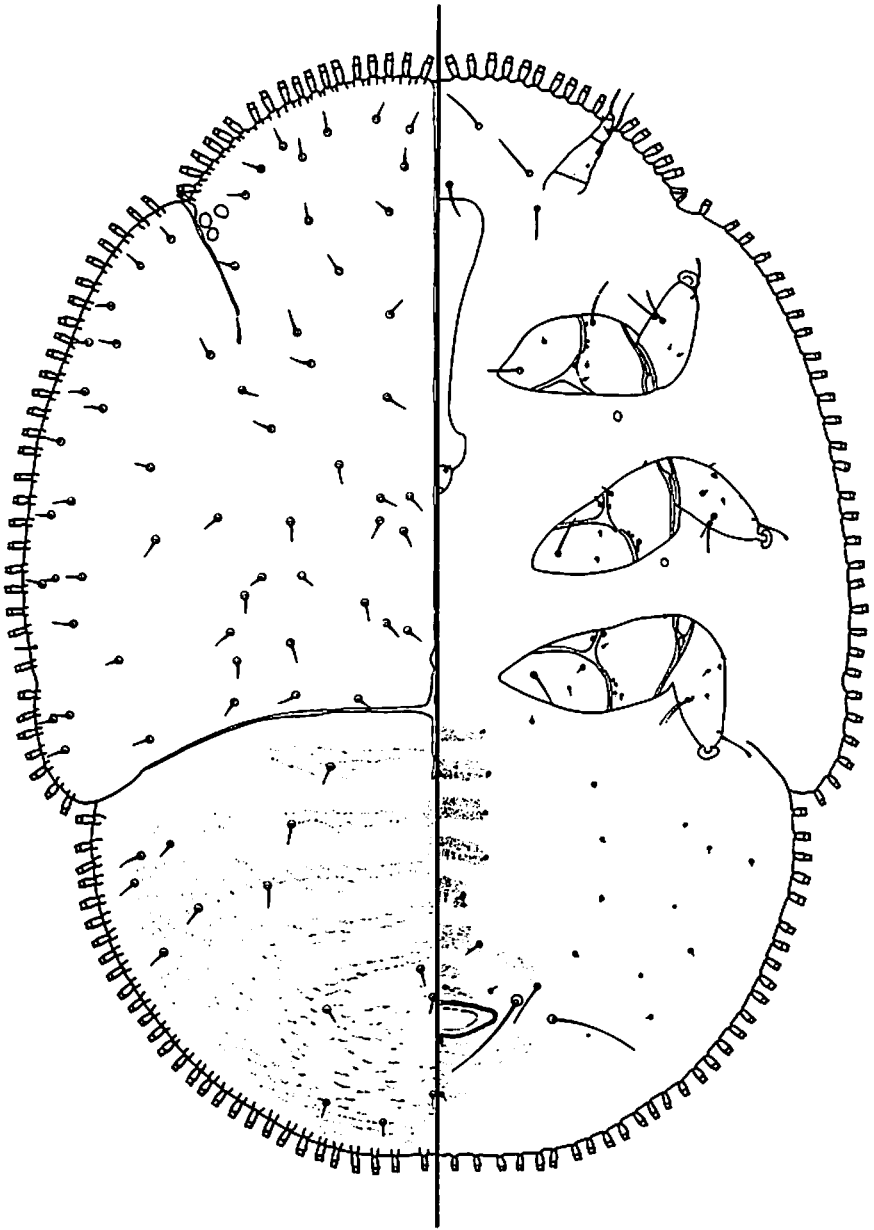


FIGURE 8. *Kuwayama ventralis*, third instar nymph, dorsal and ventral aspects.

FIFTH INSTAR (Figs. 2, M; 3, E; 10).

Dimensions. Length 2.00-2.12; width 1.59-1.70.

Dorsum. Indumenta: sectasetae (Figs. 2, M lower). Setae (Fig. 2, M upper) more numerous than fourth instar.

Venter. Indumenta: setae on abdomen in cluster of 3-4 arranged in submedial longitudinal row on each side. **Antennae:** six segmented; basal segment with 2 dorsal setae (1 submedial, 1 subapical); with 2 sensoria (1 dorsal near base, 1 subapical); second segment with 1 subapical seta and 1 subapical sensorium; third segment with 1 subapical sensorium; fourth segment with 1 subapical specialized seta; fifth segment without setae and sensoria; apical segment resembling fourth instar. **Legs:** pro- and mesofemora with 4, and metafemora with 5 sensoria near base. **Circumanal pore ring** (Fig. 3, E).

Types. Holotype male, allotype female, Hawaii, Kauai I., Kokee, Lapa Picnic Area, 28•II•1988, ex *Pisonia sandwicensis*, G.K. Uchida (BISHOP). Paratypes with same locality data as holotype, 2 males, 2 females and 21 nymphs (5 I, 4 II, 4 III, 4 IV, 4 V).

Kuwayama oahuensis, n. sp. (Figs. 2, B, E, H, K, N; 4, A-E).

Adult.

Diagnosis. This species can be distinguished from *K. lanaiensis* by the position of the M fork which occurs on a straight line connecting distal ends of the Rs and Cu₁ veins and from *K. ventralis* by the previously mentioned character and absence of markings on dorsum of mesothorax and wings.

Dimensions. Male: length from front of head to tip of wing 3.7; body: length 1.7, width 0.5; anterior wing: length 3.2, width 1.2. **Female:** length from front of head to tip of wing 4.3; body: length 1.9, width 0.6; anterior wing: length 3.6, width 1.4.

Color. General color pale brown. **Head:** markings absent, antenna terminal segments brown. **Thorax:** markings absent. **Wings:** markings absent. **Legs:** tibia with 2 brown spurs. **Abdomen:** brown dorsally; male, forceps brown apically; female, anal valves without markings.

Immature Stages.**FIRST INSTAR** (Figs. 2, B; 4, A).

Dimensions. Length 0.37-0.40; width 0.24-0.25.

Dorsum. Indumenta: sectasetae present in single marginal row, weakly lanceolate, apex emarginate: marginal sectasetae (Fig. 2, B lower left) corresponding in position to submarginal row of sectasetae of *K. ventralis*, with distal portion about 1/2 of entire length; other sectasetae (Fig. 2, B lower right) corresponding in position to marginal sectasetae of *K. ventralis*, with distal portion about 1/3 of entire length. Setae (Fig. 2, B upper).

Venter. Circumanal pore ring (Fig. 4, A).

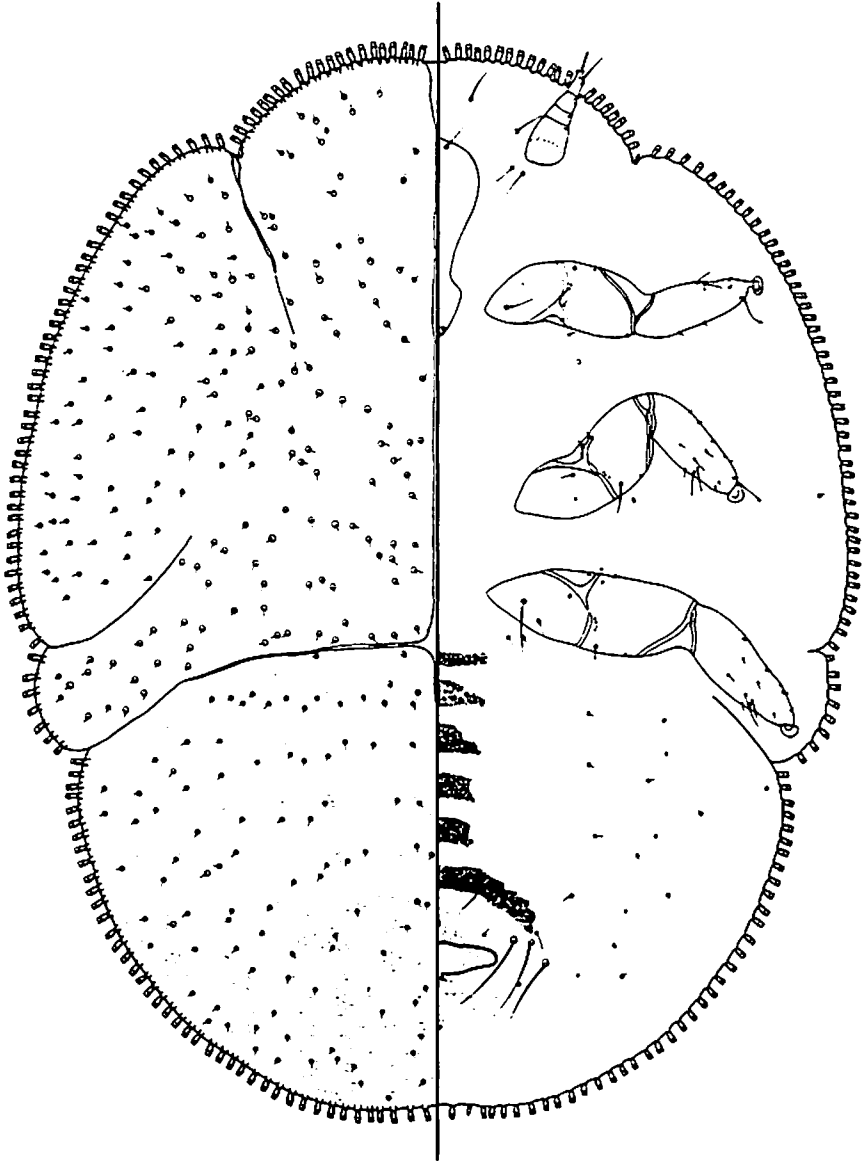


FIGURE 9. *Kuwiyama ventralis*, fourth instar nymph, dorsal and ventral aspects.

SECOND INSTAR (Figs. 2, E; 4, B).

Dimensions. Length 0.53-0.55; width 0.40-0.41.

Dorsum. Indumenta: sectasetae (Fig. 2, E lower) with distal portion about $\frac{1}{3}$ of entire length. Setae (Fig. 2, E upper). **Circumanal pore ring** (Fig. 4, B).

THIRD INSTAR (Figs. 2, H; 4, C).

Dimensions. Length 0.79-0.82; width 0.61-0.64.

Dorsum. Indumenta: sectasetae (Fig. 2, H lower). Setae (Fig. 2, H upper).

Venter. Circumanal pore ring (Fig. 4, C).

FOURTH INSTAR (Figs. 2, K; 4, D).

Dimensions. Length 1.32-1.36; width 0.98-1.00.

Dorsum. Indumenta: sectasetae (Fig. 2, K lower). Setae (Fig. 2, K upper).

Venter. Circumanal pore ring (Fig. 4, D).

FIFTH INSTAR (Figs. 2, N; 4, E).

Dimensions. Length 1.96-2.20; width 1.53-1.66.

Dorsum. Indumenta: sectasetae (Fig. 2, N lower). Setae (Fig. 2, N upper).

Venter. Circumanal pore ring (Fig. 4, E).

Types. Holotype male, allotype female, Hawaii, Oahu I., Waianae Mts., gulch below Puu Kaua, 19-II-1989, ex *Pisonia sandwicensis*, G.K. Uchida (BISHOP). Paratypes, 4 males, 5 females, 15 nymphs (3 I, 3 II, 3 III, 3 IV, 4 V), same locality data as holotype.

Kuwayama lanaiensis, n. sp. (Figs. 2, C, F, I, L, O; 5, A-E).

Adult.

Diagnosis. This species can be distinguished from *K. ventralis* by the absence of markings, and from *K. oahuensis* by the position of the M fork which occurs distal to a straight line connecting the distal ends of Rs and Cu₁ veins.

Dimensions. Male: length from front of head to wing tip 2.8; body: length 1.5, width 2.2; anterior wing: length 2.2, width 0.9. **Female:** length from front of head to wing tip 3.2; body: length 1.5, width 0.5; anterior wing: length 2.6, width 1.1.

Color. Fitting description of *K. oahuensis*.

Immature Stages.**FIRST INSTAR** (Figs. 2, C; 5, A).

Dimensions. Length 0.37-0.38; width 0.23-0.24.

Dorsum. Indumenta: sectasetae present in single marginal row, weakly lanceolate, apex emarginate: sectasetae (Fig. 2, C lower left) corresponding in position to submarginal (Fig. 2, A lower left) and marginal (Fig. 2, C

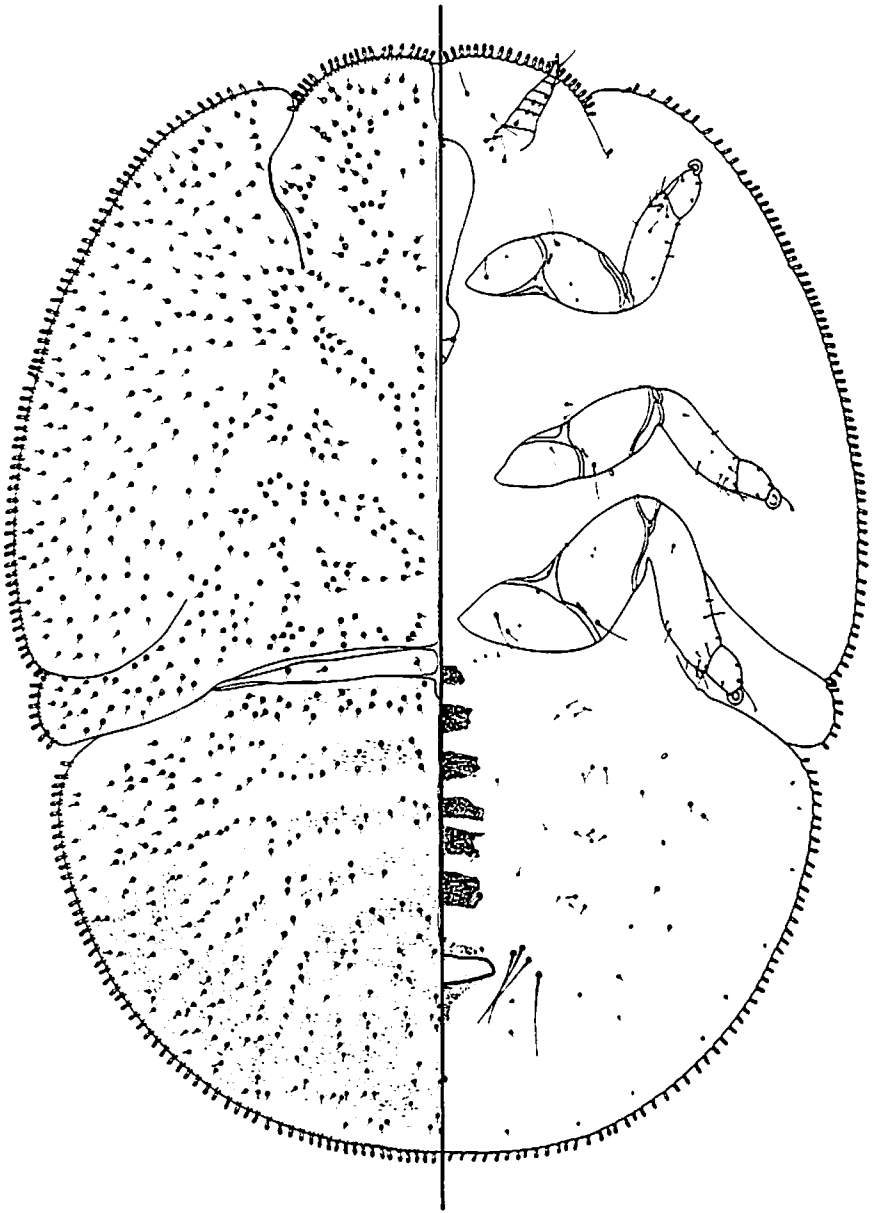


FIGURE 10. *Kuuyama ventralis*, fifth instar nymph, dorsal and ventral aspects.

lower right) rows of *K. ventralis*, with distal portion about 1/4 of entire length. Setae (Fig. 2, C upper).

Venter. Circumanal pore ring (Fig. 5, A).

SECOND INSTAR (Figs. 2, F; 5, B).

Dimensions. Length 0.52-0.54; width 0.37-0.41.

Dorsum. Indumenta: sectasetae (Fig. 2, F lower). Setae (Fig. 2, F upper).

Venter. Circumanal pore ring (Fig. 5, B).

THIRD INSTAR (Figs. 2, I; 5, C).

Dimensions. Length 0.77-0.81; width 0.55-0.58.

Dorsum. Indumenta: sectasetae (Fig. 2, I lower). Setae (Fig. 2, I upper).

Venter. Circumanal pore ring (Fig. 5, C).

FOURTH INSTAR (Figs. 2, L; 5, D).

Dimensions. Length 1.11-1.12; width 0.80-0.82.

Dorsum. Indumenta: sectasetae (Fig. 2, L lower). Setae (Fig. 2, L upper).

Venter. Circumanal pore ring (Fig. 5, D).

FIFTH INSTAR (Figs. 2, O; 5, E).

Dimensions. Length 1.74; width 1.30.

Dorsum. Indumenta: sectasetae (Fig. 2, O lower). Setae (Fig. 2, O upper).

Venter. Circumanal pore ring (Fig. 5, E).

Types. Holotype male, allotype female, Hawaii, Lanai I., North Hauola Ridge, 12•VI•1989, ex *Pisonia sandwicensis*, G.K. Uchida & J. Lau (BISHOP). Paratypes, 1 male, 2 females, nymphs (4 I, 3 II, 4 III, 2 IV, 1 V), same locality data as holotype.

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