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A NEW JAPANESE SPECIES OF *TRIOZA* FROM *MACHILUS THUNBERGII*, WITH DESCRIPTIONS OF THE IMMATURE STAGES AND NOTES ON BIOLOGY  
(HEMIPTERA : PSYLLIDAE)\*

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Among species of *Trioza* occurring in Japan, *T. camphorae* Sasaki and *T. cinnamomi* (Boselli) are known feeding on the plants of family Lauraceae. The present new species seems to be a serious pest of *Machilus thunbergii* belonging to the same family. As it resembles the foregoing psyllids morphologically and biologically in addition to similarity of host relation, it can be placed in the same species group. In the present paper, adult and developmental stages are described in detail and its biology is briefly noted.

Before going further, I wish to express my sincere appreciation to Prof. K. Yasumatsu of the Entomological Laboratory, Kyushu University for his kind guidance, and to Dr. K. Baba, Prof. S. Miyamoto and Mr. M. Shiga for their kindness on material.

*Trioza machilicola* sp. nov.

Color: General color dark brown to black. Genal cones dark brown to black basally and yellowish or whitish apically and ventrally. Antenna brownish orange, with two apical segments black. Eyes black; ocelli red. Forewing transparent, faintly flavous, with veins light brown. Hind wing almost transparent, with dense microscopic granules entirely as figured (Fig. 1-B), especially dense at posterior margin. Legs brownish yellow; coxae brown (metacoxa yellowish brown), posterior femur dark brown; apical spurs of posterior tibia and claws black. Abdomen dark brown to black, except for genital segments yellowish brown to brown; intersegmental membrane white.

Structure: Head (Fig. 1-C) nearly as wide as thorax, vertical; vertex slightly deflexed, longer than half as long as wide on median line, shallowly depressed posteriorly on each side of median line, rugose uniformly, with hairs along anterior margin; genal cones short, 1/2 as long as vertex, vertical, strongly divergent, with long hairs

\* Contributions from the Osaka Museum of Natural History, No. 128.

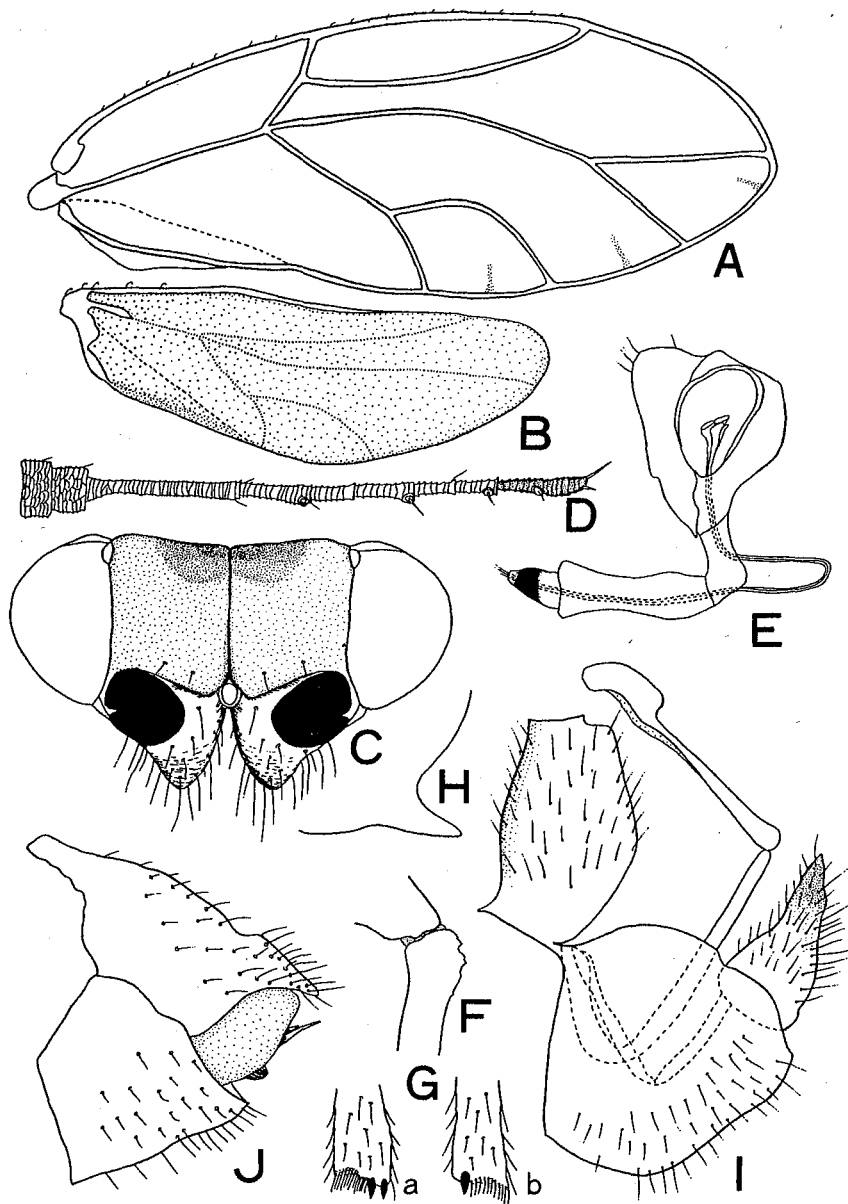


Fig. 1. Adult of *Trioza machilicola* sp. nov.

A, Forewing; B, Hind wing; C, Head (antennae excluded), frontal view; D, Antenna; E, Mouth parts; F, Basal spur of posterior tibia; G, Apex of posterior tibia (a, inner side; b, outer side); H, Meracanthus; I, Male genitalia; J, Female genitalia.

sparsely, with apex subacute; occiput depressed; clypeus (Fig. 1-E) not strongly produced forward, with 3 or 4 long hairs on upper edge; relative length of 1st labium, 2nd lab. and 3rd lab. as 1: 2: 0.7. Antenna short, slightly longer than width of head, with large sensoria at apices of IV, VI, VIII and IX; apex with 1 long and 1 short setae; relative length of antennal segments as 1: 0.9: 4.5: 2: 1.2: 1.7: 1.1: 1.1: 1.3: 1.2.

Thorax moderate in size, without conspicuous pubescence, rugose; pronotum almost vertical; praescutum convex; scutum rather flat; scutellum conversely trapezoidal, about 2/3 as long as wide. Forewing (Fig. 1-A) elongate, about 2.7 times as long as wide, narrow basally, subangulate at apex; Rs very short, arched; relative length of veins Cu, Cu<sub>2</sub>, M<sub>1+2</sub>, M<sub>3+4</sub> as 2: 1: 2: 1.5; both marginal cells somewhat quadrilateral, cubital cell high. Hind wing (Fig. 1-B) about 2/3 as long as forewing, with sinuate anterior margin, with posterior margin arched; rounded apically; R and M without subdivision; C+Sc with 5 hooked frenulum basally. Legs short, hairy; posterior tibia with 2 or 3 basal spurs (Fig. 1-F), with 1 outer (b) and 2 inner (a) apical spurs (Fig. 1-G), with comb-like bristles along apical margin; proximal segment of posterior tarsi without apical spurs, meracanthus (Fig. 1-H) moderately long, slender, projected ventro-caudad, subacute at apex. Abdomen (excl. genital segments) short, nearly as long as width of mesothorax, almost bare dorsally, with pubescence ventrally.

Male genitalia (Fig. 1-I) moderately large, about 1/2 as long as the rest of abdomen; proctiger in lateral view stout, with anterior margin nearly straight, with posterior margin rounded caudad, truncate horizontally at apex, with long hairs; forceps small, subtriangular in lateral view, distinctly shorter than proctiger, broad at base, tapering to acute apices, strongly pubescent on posterior margins; subgenital plate higher than long, with sparse hairs ventrally; aedeagus long, with second segment thickened apically, relative length of first segment and second segment as 9: 7. Female genitalia (Fig. 1-J) nearly 2/3 as long as the rest of abdomen; dorsal valve in lateral view longer than ventral, with dorsal margin with depression midway as figured, apical portion attenuate, with long setae, with apex acute; inner valve nearly as long as dorsal or longer; ventral valve high, nearly quadrilateral, with stiff hairs ventrally.

Length of body ♂ 1.0-1.2 mm, ♀ 1.3-1.5 mm (to tip of folded wings ♂ 2.0-2.3 mm, ♀ 2.4-2.7 mm); length of forewing ♂ 1.7-1.9 mm, ♀ 2.0-2.3 mm; width of forewing ♂ 0.6-0.7 mm, ♀ 0.8-0.9 mm; length of hind wing ♂ 1.2-1.3 mm, ♀ 1.4-1.5 mm; length of antenna ♂ 0.5-0.6 mm, ♀ 0.5-0.6 mm.

Holotype: ♂, Hirao, Fukuoka City, Kyushu, 30. iv. 1962, on *Machilus thunbergii*, Y. Miyatake leg. (deposited in the collection of the Osaka Museum of Natural History).

Paratopotypes: 16♂♂ 36♀♀, the same data as the holotype on the same host tree; 2♀♀, 15. iv. 1960; 2♂♂ 4♀♀, 15. iv. 1959; 3♂♂ 2♀♀, 2. iv. 1959; 3♂♂ 2♀♀, 17. iv. 1958; 2♂♂, 12. iv. 1958; 5♀♀, 1. v. 1958; on *Machilus thunbergii*, Y. Miyatake leg. Paratypes: 1♂ 1♀, Mt. Hōman, Fukuoka Pref., 20. v. 1962, M. Shiga leg. 3♂♂ 1♀, Mt. Tachibana, Fukuoka City, 6. v. 1962, S. Miyamoto leg. 1♀, 3. v. 1962; 4♂♂ 4♀♀, 10-12. v. 1958 (on "Yamazakura"-*Prunus sargentii*); Hikosan, Fukuoka Pref., Y. Miyatake leg. 5♂♂ 8♀♀, Mt. Fukuchi, Fukuoka Pref., 5. v. 1962, on *Machilus thunbergii*, Y. Miyatake leg. 25♂♂ 8♀♀, Gatsugi, N. Niigata Pref., 4. vi. 1967, on *Machilus thunbergii*, K. Baba leg. 14♂♂ 10♀♀, Kasugayama (Myōken-gū), Nara City, 12. v. 1968, on *Machilus japonica*, Y. Miyatake leg. (Paratypes are deposited in the collections of the Osaka Museum of Natural History, the Entomological Laboratory of Kyushu University, the Entomological Laboratory of Ehime University, the British Museum of Natural History and the United States National Museum).

In addition, many examples of the second instar nymphs were found from the Herbarium of Osaka Museum of Natural History as follows:

Mt. Tanjō (alt. 515 m), Hyogo-ku, Kobe City, 27. x. 1963, K. Seto leg.; Yobe, Kinosaki-gun, Hyogo Pref., 18. x. 1936, M. Kuwashima leg.; Hiyoriyama, Kinosaki-chō, Kinosaki-gun, Hyogo Pref., 13. vi. 1964, S. Nakanishi leg.; on *Machilus thunbergii*. Hara, Takatsuki City, Osaka Pref., 5. vi. 1955, M. Kuwashima leg.; Ōsugidani near Honzanji, N. Takatsuki City, Osaka Pref., 18. viii. 1956, M. Hotta leg.; Yoshimine, Otokuni-gun, Kyoto Pref., 6. viii. 1952, M. Hotta leg.; on *Machilus japonica*.

Distribution: Japan (Fukuoka Pref., Nara Pref., Osaka Pref., Kyoto Pref., Hyogo Pref., Niigata Pref.). This psyllid occurs in Niigata Prefecture, which is almost the northernmost of its host range. Therefore, it is undoubtedly much more wide-spread throughout the range of its host plant.

Host plants: "Tabunoki"-*Machilus thunbergii* Sieb. et Zucc. (Lauraceae). Adults and eggs, confirmed at Hirao, Fukuoka City in April, 1959; nymphs, confirmed at Hirao, Fukuoka City in February, April and May, 1959. "Aogashi" or "Hosobatabu"-*Machilus japonica* Sieb. et Zucc. (Lauraceae). Adults, eggs, nymphs and galls, confirmed at Kasugayama, Nara City in May, 1968.

The distributional range of *Machilus thunbergii* extends continuously or intermittently from the Ryukyu Islands to almost the northern extremity of Honshu mainland along the coastal regions in Japan, not only the Pacific side but also the Japan sea side.

This new species differs from *Trioza camphorae* Sasaki in coloration of body, in having genal cones bicolor (dark brown basally and yellowish apically), male forceps not broad midway, ventral valve of female genitalia not triangular but quadrilateral. Differs from *T. cinnamomi* (Boselli) in coloration and being much smaller, in having median cell somewhat quadrilateral, because  $M_{1+2}$  does not reach apex of forewing (triangular in *T. cinnamomi*), the 4th segment of antenna distinctly longer than the 5th (nearly equal in *T. cinnamomi*). Differs from *T. formosana* Kuwayama in being smaller (body ♂ 1.5–1.6 m, ♀ 1.6–1.7 mm in *T. formosana*), in coloration of genal cones (uniformly orange yellow in *T. formosana*), in having cubital cell somewhat parallelogramy (subtriangular in *T. formosana*), male forceps not falcated as in *T. formosana* apically, dorsal valve of female genitalia with dorsal margin upcurved midway. Differs from *T. galii* Förster in having shorter antenna (slightly longer than width of head, though 2 times as long as width of head in *T. galii*), antenna with segments wholly yellow except for two apical segments black (only the 3rd segment yellow in *T. galii*), genal cones bicolor (entirely black in *T. galii*), medial cell of forewing much larger, and in the structure of genitalia.

Kieffer described *Neotrioza machili* in 1905, whose host was *Machilus gamblei*, from Bengal. Although the present new species seems to be related to his species in the host-relation, the gall-making habit and the forewing with apex not acute, it can be easily distinguished from the latter in dimensions of adult, having forewing with Rs short and strongly arched,  $M_{1+2}$  not arched but nearly straight, and cubital cell much higher, having posterior tibia with basal spurs more or less conspicuous,

in different shape and size of gall, according to Kieffer's description. He may have erected the genus *Neotrioza* mainly basing upon the character of forewing having apex, which is not acute as typical in the genus *Trioza*. This characteristic seems to be insufficient to warrant any such generic distinction. Owing to unavailability of material of Kieffer's species, the matter regarding generic distinctness of the genus *Neotrioza* and relationship between the present new species and Kieffer's species should be suspended for the present, however.

### Descriptions of the developmental stages

#### A. Egg (Fig. 2-0)

Length 0.26-0.31 mm, width 0.09-0.10 mm.

Elongate oval in shape, slender, not convex midway. Attached to leaves by short stalk at base, with spine-shaped projection ranging from 0.06 mm to 0.07 mm in length at apex. Pale yellow for a short while after oviposition, becoming bluish brown gradually, and appearing dark brown just before hatching. Surface of egg-shell with microscopical mesh-like structure constructed by irregular pentagons or hexagons (Fig. 2-0r).

#### B. Nymphs

There are five nymphal instars readily distinguishable by the number of antennal segments, the size and shape of the wing pads, the number of marginal setae and circum-anal pores, etc.

#### Key to the nymphal instars

- 1 (2) Antenna with 2 segments, with 1 sensorium on apical segment. Small setae on dorsum absent; marginal setae 26 in number on each side. Wing pads unrecognized. Circum-anal pore ring consisted of single row with 36-40 pores. Leg without claw, with 2 long setae at apex ..... First instar
- 2 (1) Antenna with more than 5 segments. Small setae on dorsum present. Wing pads more or less prominent. Circum-anal pore ring consisted of double rows. Leg with claw, with 1 long seta at apex.
- 3 (6) Antenna with 5 or 6 segments, with less than 3 sensoria. Mesothorax not conspicuously divided from metathorax. Leg with 1 claw.
- 4 (5) Antenna with 5 segments, with 1 sensorium on IV. Body margin with 54-55 setae on each side. Outer circum-anal pore ring with about 56 pores, inner ring with 35-42 pores ..... Second instar
- 5 (4) Antenna with 6 segments, with 3 sensoria on III, IV, V. Body margin with 80-92 setae on each side. Outer circum-anal pore ring with 64-76 pores, inner ring with 52-56 pores ..... Third instar
- 6 (3) Antenna with 7 or 8 segments, with 4 sensoria. Mesothorax conspicuously divided from metathorax. Leg with 2 claws.
- 7 (8) Antenna with 7 segments, with 4 sensoria on III, IV, VI, VII. Body margin with 114-134 setae on each side. Outer circum-anal pore ring with 104-110 pores, inner ring with 68-72 pores. Tibio-tarsal articulation absent ..... Fourth instar

- 8 (7) Antenna with 8 segments, with 4 sensoria on III, V, VII, VIII. Body margin with 162-191 sectasetae on each side. Outer circum-anal pore ring with 150-160 pores, inner one with 106-116 pores. Tibio-tarsal articulation well defined ..... Fifth instar

a) First instar (Fig. 2-1)

Length 0.27-0.31 mm, width 0.13-0.15 mm ..... soon after hatch.

Length 0.33-0.39 mm, width 0.16-0.20 mm ..... just before molt.

Body cocoon-shaped, pale green and semitransparent immediately after hatch, becoming pale yellow gradually. Central part of head and abdomen deep yellow. Head and prothorax fused completely, with membranous area along center line, margin with 12 sectasetae on each side (the last pair apart far behind eyes), ventral side with a pair of long hairs anteriorly, 5 hairs on clypeus and a pair of long hairs near base of antennae. Antenna (Fig. 2-1a) long, 0.05-0.06 mm, 2-segmented, basal segment about 1/5 as long as apical segment, with 1 big sensorium on the latter, with 1 long stout and 1 short slender setae near apex. Eyes reddish brown, 4-faceted. Wing pads not defined yet. Mesothorax and metathorax with a pair of sectasetae at margins and spiracles ventrally. Legs large, stout, well developed; coxa with a long hair; femur with several short hairs; tibio-tarsal articulation lacking, tibiotarsus (Fig. 2-1t) with 2 long apical setae, apical one of which is stout and hooked apically, with large sensorium at apex, without claw and conspicuous circular pulvillus. Abdomen well segmented by membrane, the VII and the VIII fused; margin with 12 sectasetae (Fig. 2-1s) on each side; ventral side with 4 pairs of spiracles laterally, with 4 pairs of hairs near V-shaped anus; circum-anal pore ring with 36-40 pores.

b) Second instar (Fig. 2-2)

Length 0.43-0.52 mm, width 0.30-0.33 mm.

Body regularly oval; pale yellow and semitransparent soon after molt, becoming opaque, yellowish or pale white, having obscure maculation dorsally on head and abdomen in hibernating form; dorsum somewhat rugose. Head and prothorax fused completely; margin with 15-17 sectasetae on each side; ventral side with some short hairs near antenna, on clypeus and 3rd labium. Articulation between prothorax and mesothorax obscure. Antenna (Fig. 2-2a) short, narrowly triangular, 0.04-0.05 mm, 5-segmented as 1: 1: 1: 1: 2 in relative length; with 1 large sensorium on IV, with 2 apical setae. Eyes small. Articulation between mesothorax and metathorax lacking; wing pads slightly developed, anterior wing pad with 14-15 sectasetae and posterior pad with 6-8 sectasetae, with 2 pairs of spiracles ventrally. Legs short, slender; coxa with 1 long and 1 short hairs; femur short, as long as coxa; tibio-tarsal articulation lacking, tibiotarsus with 1 long hooked seta dorsally and 1 large sensorium ventrally, with undeveloped pulvillus and 1 weak claw at apex. Abdomen prominently segmented; margin with 17-19 sectasetae (Fig. 2-2s) on each side; ventral side with hairs and 4 pairs of spiracles, with anus of long sideways and  $\sim$ -shaped, outer circum-anal pore ring with 56-60 pores, inner ring with 38-42 pores.

c) Third instar (Fig. 2-3).

Length 0.55-0.60 mm, width 0.35-0.43 mm.

Body broadly oval, brownish yellow. Head and prothorax fused completely; artic-

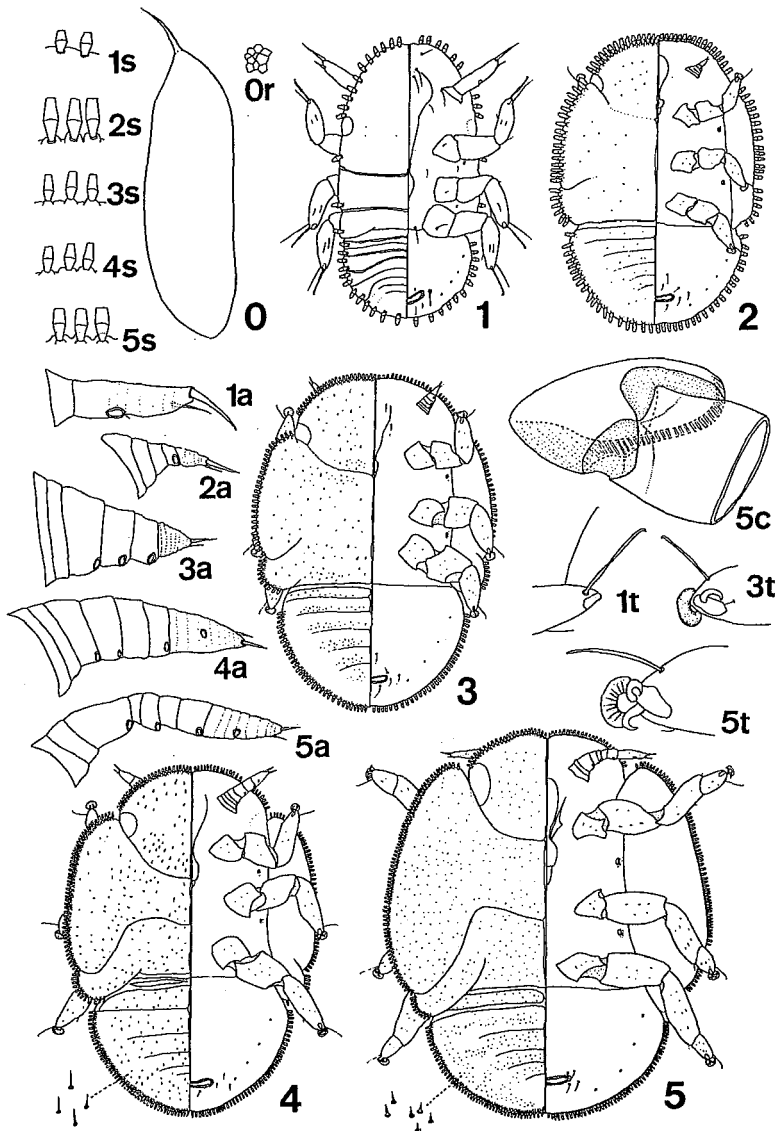


Fig. 2. Egg and nymphs of *Trioza machilicola* sp. nov.

0, Egg (Or, part of meshes on surface); 1, First instar (1a, antenna; 1s, marginal sectasetae of abdomen; 1t, apex of tibiotarsus); 2, Second instar (2a, antenna; 2s, marginal sectasetae of abdomen); 3, Third instar (3a, antenna; 3s, marginal sectasetae of abdomen; 3t, apex of tibiotarsus); 4, Fourth instar (4a, antenna; 4s, marginal sectasetae of abdomen); 5, Fifth instar (5a, antenna; 5s, marginal sectasetae of abdomen; 5c, coxa and trochanter of posterior leg; 5t, apex of posterior tarsus).

ulation between prothorax and mesothorax definite, with rather broad membranous area. Entire dorsum of thorax and abdomen with minute sectasetae sparsely, which secrete slender, white, fibroid wax. Head+prothorax with 20-23 sectasetae on each side along margin. Antenna (Fig. 2-3a) short, stout, almost triangular about 0.07 mm, 6-segmented, relative length of each segment as 1.5 : 2 : 5 : 4 : 3 : 5; with 3 large sensoria on III, IV, V; with 2 apical setae. Wing pads developed more laterally than the preceding stages, margin with 22-28 sectasetae on anterior pad and 9-10 sectasetae on posterior pad. Thorax with 2 pairs of large spiracles ventrally. Legs large, stout, lighter in color than body; coxa with 1 long and 2 short hairs; femur as long as coxa, with 1 long hooked seta dorsally and large sensorium ventrally near apex, with developed pulvillus and 1 long, falcate claw at apex (Fig. 2-3t). Abdomen segmented rather obscurely; margin with 28-30 sectasetae (Fig. 2-3s) on each side; with few hairs and 4 pairs of large spiracles ventrally; outer circum-anal pore ring with 64-76 pores, inner ring with 52-56 pores.

d) Fourth instar (Fig. 2-4)

Length 0.71-0.86 mm, width 0.57-0.64 mm.

Body more broadly oval, brownish yellow, darker on marginal area, grayish along median line on thoracic dorsum. Head and prothorax fused completely, though division between prothorax and mesothorax prominent, margin with 25-30 sectasetae on each side. Entire dorsum of head through abdomen with rather long lanceolate setae rather densely, which secrete white thread-like wax. Antenna (Fig. 2-4a) long, brown, 0.12-0.13 mm, 7-segmented, relative length of each segment as 1.5 : 2 : 3.5 : 4.5 : 4 : 3 : 11; with 4 large sensoria on III, IV, VI, VII; with 1 long and 1 short apical setae. Wing pads well developed, conspicuously produced anteriorly and laterally, anterior pad with 48-53 sectasetae and posterior pad with 8-10 sectasetae on each side of margin. Legs developed; coxa with several short hairs; femur larger than coxa; tibio-tarsal articulation lacking, tibiotarsus with 1 long hooked seta dorsally and complex sensorium ventrally near apex, with well developed circular pulvillus and 2 short claws, at apex. Abdominal segmentation not defined, except for the first segment which is well separated from the rest by membrane; margin with 40-46 sectasetae (Fig. 2-4s) on each side; ventral side of abdomen with 10 pairs of hairs near anus, with 4 pairs of small spiracles; anus  $\sim$ -shaped, outer circum-anal pore ring with 104-110 pores, inner ring with 68-72 pores.

e) Fifth instar (Fig. 2-5)

Length 1.0-1.1 mm, width 0.8-1.0 mm.

Body somewhat irregularly quadrilateral, entirely flat, brown, lighter in color near margin, thoracic dorsum grayish along median line and rugose, entire dorsum on head through abdomen with minute lanceolate setae densely which are shorter than that of the fourth instar and secrete thread-like wax. Head and prothorax fused completely, with 27-33 sectasetae at margin on each side; head+prothorax well separated from mesothorax by membrane. Antenna (Fig. 2-5a) long, slender, 0.22-0.23 mm, 8-segmented, relative length of each segment as 2 : 2.5 : 9 : 1.5 : 2.5 : 3 : 4 : 11; with 4 big sensoria on III, V, VII, VIII; with 1 short, stout and 1 long, slender setae at apex. Eyes



reddish brown, elongate, large. Wing pads prominently developed, with humeral angle produced forward to anterior margins of eyes, also laterally and backward, anterior pad with 72-83 sectasetae and posterior pad with 8-10 sectasetae at margin on each side. Thoracic spiracles large. Legs well developed, long and stout; coxa with several short hairs; femur and trochantal area distinguishable by transverse suture (Fig. 2-5c); femur with several short hairs; tibio-tarsal articulation well defined; with 1 long hooked setae dorsally and sensorium ventrally near apex, with developed circular pulvillus and 2 magnificent claws at apex (Fig. 2-5t). Abdomen short, without conspicuous segmentation except for the first segment which is well separated from the rest by membrane; margin with 55-65 sectasetae (Fig. 2-5s) on each side; with 10 pairs of hairs near anus; outer circum-anal pore ring with 150-160 pores, inner ring with 106-116 pores.

### Biology

This triozone psyllid has but one generation per year. The adults begin to appear from the middle of March, most abundant in April at Fukuoka. They are usually found sucking on young shoots, but frequently sucking on the vacant galls under side of old leaves (observed on April 12th of 1958 and April 15th of 1959 at Hirao, Fukuoka City).

Copulating soon after emergence, females start to lay eggs from late in April, continuously till the beginning of May, mostly on tops of buds. Sometimes, one bud is covered by too many females, thus it looking entirely black. Eggs are usually laid singly or in small scatters or groups, but when females are numerous, hundreds may be placed on the same bud or young leaf. The period of incubation reveals about ten days. From the beginning to the middle of May, the first instars begin to hatch. On hatching, the first instars walk around and settle on under surfaces of the young leaves after soon and begin to feed, and thus the sedentary stage continues through their nymphal stages. At the end of the first stage, the pit gall grows up to  $0.4 \times 0.3$  mm in diameter and conspicuously produced on dorsal surface of the leaf. After 10 to 13 days the first instar molts to become the second instar in the middle of May through late May. The pit gall in the second stage becomes larger than that of the first stage, about  $0.6 \times 0.4$  mm in diameter. Number of the gall (number of the nymph) per leaf varies from 200 to 500 frequently. The second instar passes the summer and the winter, and appears to be the third instar late in February to early in March of the next year. The period of the second instar thus extends over 9 months. The period of the third instar is about 7 days and 10-13 days for the fourth instar. From the middle of March to late March, nymphs come to the fifth instar and their developments are complete after about 10 days. Emergence occurs where they grew up under surface of the leaf. In the later period of occurrence, tremendous crowd of adults leave the host tree and scatter around the neighboring trees (usually deciduous trees, e.g. *Prunus* sp., *Acer* sp.) for feeding. They scarcely survive until the end of May in Fukuoka Prefecture.



Fig. 3. Galls of *Trioza machilicola* sp. nov. on *Machilus thunbergii*  
(Photograph by Mr. I. Hiura).

Parasites and predators:

(1) *Prionomitus* sp. (Family Encyrtidae)

Between April 27 and May 3 in 1959, 74 males and 64 females of this species emerged from the nymphs (mostly 4th or 5th instars) which were previously collected during the period from March 20 to April 15 in 1959 at Hirao, Fukuoka City. It seems that the percentage of parasitism appears to be fairly high. On May 19, 1959 four females were observed laying eggs in the 2nd instars of *Trioza machilicola* at Hirao, Fukuoka City.

(2) *Eocaria mui* Timberlake (Family Coccinellidae)

Many adults of this species were found preying the adults of *T. machilicola* on April 15, 1959 at Hirao, Fukuoka City.

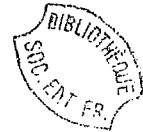
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