

# The First Record of *Tetraneura triangula* Zhang & Zhang, 1991 (Hemiptera: Aphididae: Eriosomatinae) from Korea

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## 한국의 미기록종 *Tetraneura triangula* Zhang & Zhang, 1991 (노린재목: 진딧물과: 면충아과)에 대한 보고

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**ABSTRACT:** In this study, *Tetraneura triangula* Zhang & Zhang, 1991 is reported for the first time in Korea. Species distribution, measurement, host plants, description, and illustrations of diagnostic characters for emigrant and embryo are provided.

**Key words:** *Tetraneura triangula*, Eriosomatinae, New record, Korea

**초 록:** 본 연구에서 *Tetraneura triangula* 를 국내에서 처음으로 보고한다. 이 종의 분포지역, 기주식물, 형태학적 정보를 제공하였다.

**검색어:** 털보배줄면충(신칭), 면충아과, 미기록, 한국

The genus *Tetraneura* is one of the bigger genera of the tribe Eriosomatini and comprised of two subgenera, *Tetraneura* and *Tetraneurella*. All species of this genus have the cast-off skin of the first-instar gall former which strongly sclerotized and characterized by species-specific features. In addition, galls produced by *Tetraneura* spp. are closed, pouch-shaped with a peduncle, and formed on the upper surface of the host leaf. In Korea, nine species have been recorded: *Tetraneura yezoensis* (Matsumura, 1917) was firstly recorded by Okamoto and Takahashi (1927); *T. ulmi* (Linnaeus, 1758) was recorded by Saito (1941); Then, five species *T. paiki* (Hille Ris Lambers, 1970), *T. radicecola* (Strand, 1929), *T. polychaeta* (Hille Ris Lambers,

1970), *T. sorini* (Hille Ris Lambers, 1970), and *T. nigriabdominalis* (Sasaki, 1899) were recorded by Hille Ris Lambers (1970); *T. iriensis* (Lee et al., 1993) and *T. pumilae* (Lee et al., 1993) were recorded by Lee, Seo and Hwang (1993). Recently, Watanabe et al. (2022) reported the name *T. nigriabdominalis* (Sasaki, 1899) is discarded as an erroneous combination, and *Tetraneura akinire* Sasaki, 1904 is adopted as a valid name. In 2019, we newly collected samples of *Tetraneura triangula* Zhang & Zhang, 1991 on *Ulmus* sp. in Korea. In this study, we report emigrant and embryo of *Tetraneura triangula* for the first time in Korea.

### Materials and methods

Samples were preserved in 95% ethanol and then mounted

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Canada balsam, following the method of Blackman and Eastop (2000). Images and measurements were taken by LEICA (DM3000 LED) and LEICA (CTR6 LED). All specimens were deposited in the Institute of Agriculture & Life Science, Gyeong-sang National University. The following abbreviations are used in morphological features: BL - body length from the head to the end of cauda; Ant.I-VI - antennal segments, respectively; Ant.VIb - antennal segment base of VI; PT - processus terminalis; URS - Ultimate rostrum segment; 1HT - first tarsal segment of hind leg; 2HT - second tarsal segment of hind leg; HTB - hind tibia; GP - genital plate; ABDT - Abdominal tergite; SIPH - Siphunculi; Co - Costa; Cu - Cubitus; M - Media; Pt - Pterostigma; Rs - Radial sector.

## Taxonomic Accounts

### *Tetraneura (Tetraneura) triangula* Zhang & Zhang, 1991 (Table 1; Figs. 1-3)

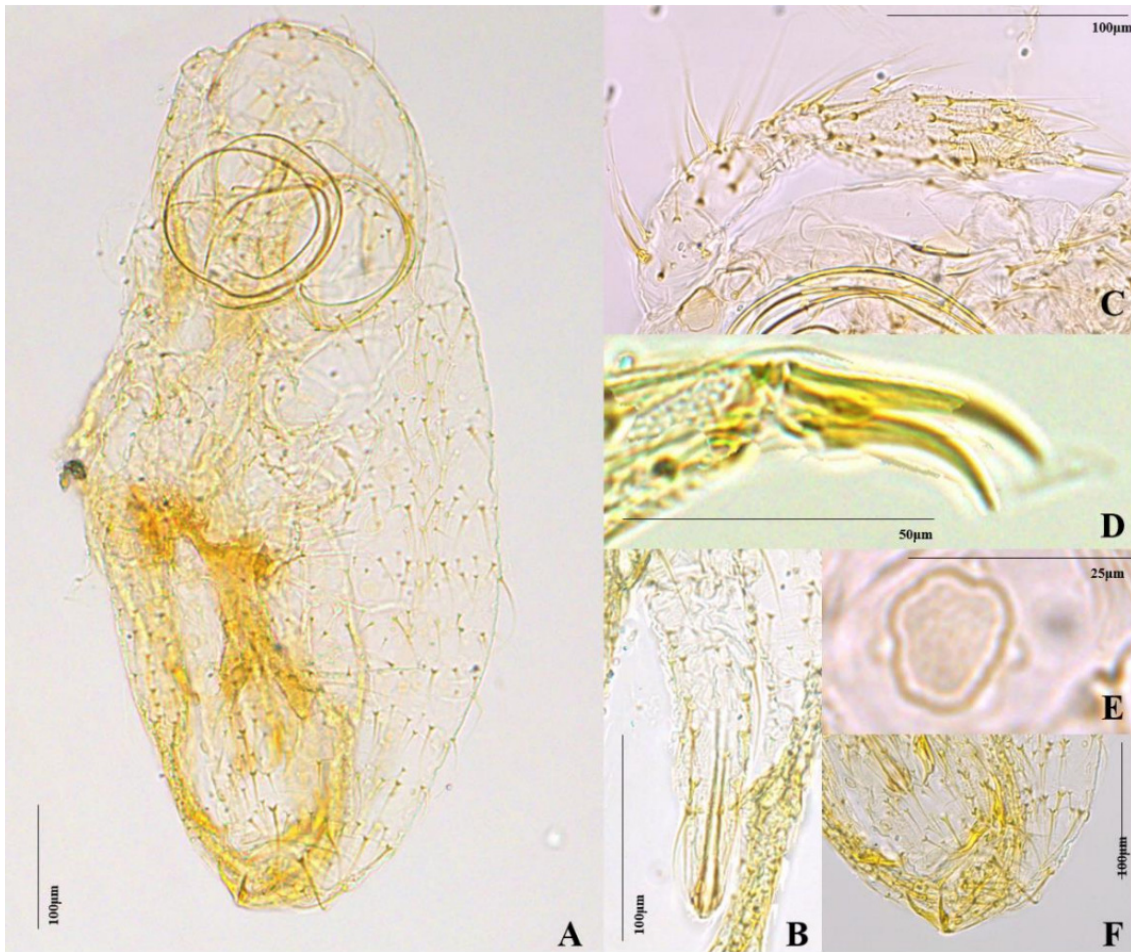
**Description. Emigrant. Morphology.** Body ovoid and plump, about 1.536-1.796 mm long; Head and thorax dark brown, with 46-48 hairs; Ant. brown, 6-segmented, Ant. 0.324-0.332 times as long as BL, Ant.III 2.239-2.565 times as long as Ant.IV, Ant.IV 0.602-0.670 times as long as Ant.V, PT 0.419-0.588 times as long as Ant.VIb, Secondary rhinaria semi-ring shaped and irregular in shape, Ant.I with 3-6 setae, Ant.II with 8-12 setae, Ant.III with 6-11 setae, bearing 10-17 secondary rhinaria, Ant.IV with 2-9 setae bearing 3-4 secondary rhinaria, Ant.V with 13-15 setae, 5-7 secondary rhinaria, Ant.VI with 1-2 secondary rhinaria, Ant.VIb with 3-4 setae, PT with 3-4 setae; Rostrum not reaching the middle coxae, URS dark brown, with 12-17 accessory setae, 0.048-0.060 times as long as BL, 0.642-0.780 times as long as 2HT; Hind coxa brown, 0.093-0.111 mm long, Hind femorotrochanter pale brown, distal 1.2 of hind femur brown, 0.394-0.411 mm long, HTB brown, 0.539-0.571 mm long, width 0.031-0.038 mm long, Tarsi similar in color to tibiae, 1HT ventral 0.026-0.041 mm long, 2HT 0.118-0.134 mm long, Hind claws 0.032-0.045 mm long; Abdomen pale brown, ABDT I-VI without sclerotizations; GP broadly oval, bearing 26-45 setae; Anal plate with 21-27 setae on the gonapophyses; SIPH absent; Cauda weakly sclerotized, dark brown with 2-4 setae. Fore wings hyaline and with M

unbranched, wing veins and stigma brown, Pt rounded and not elongated, with Cu-1a and Cu-1b separated at the base, Hind wings transparent, with one oblique veins.

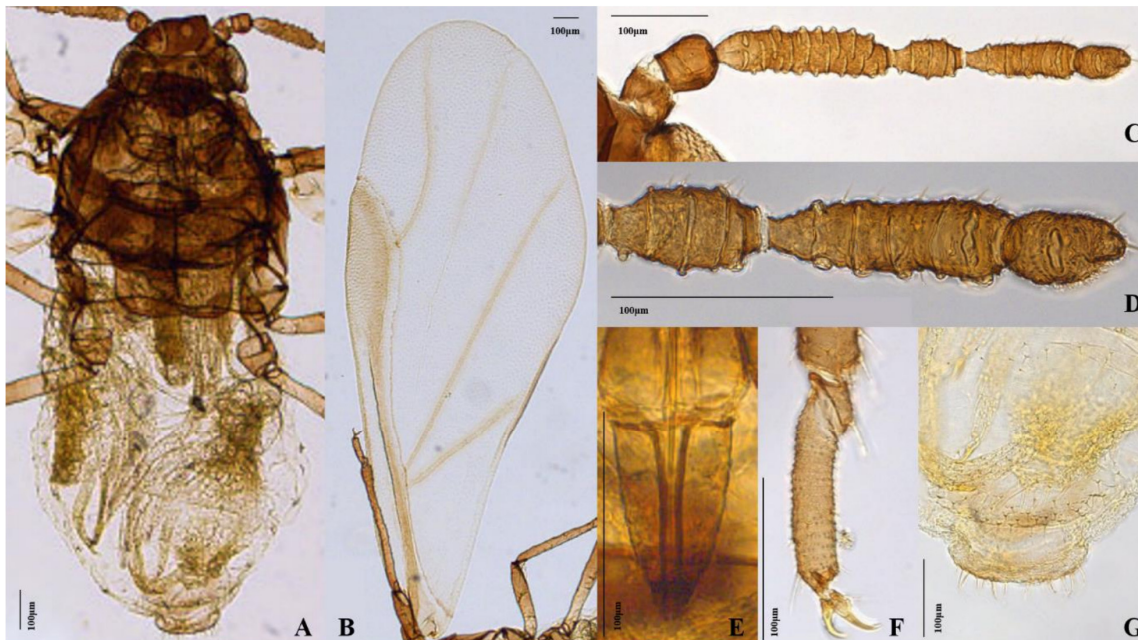
**Embryos taken from emigrant. Morphology.** BL 0.608 mm long; Ant. 5-segmented, with Ant.IV and Ant.V completely spinulose, Ant.I with 3-4 hairs, Ant.II with 7 hairs, Ant.III 3-5 hairs, Ant.IV 18 hairs, Ant.V with 8-9 hairs; Hind tarsus smooth or spinulose, 0.034-0.041 mm long; ABDT I-VI with 40-60 single pairs of rather thick marginal hairs of 0.044 mm long, pleural hairs of 0.018-0.032 mm long, ABDT IV with 40-80 hairs, ABDT VII with 30 similar hairs; Wax glands consisting of a group of cells, head present, one cell, 0.014-0.016 mm diameter on ABDT I-V.

**Table 1.** The biometric measurement of emigrant of *Tetraneura triangula* in Korea

	Body parts	Emigrant (n=6)
		Mean (range)
Length (mm)	Body	1.647 (1.536-1.796)
	Ant.	0.505 (0.497-0.512)
	Ant.I	0.042 (0.035-0.050)
	Ant.II	0.055 (0.051-0.058)
	Ant.III	0.169 (0.159-0.179)
	Ant.IV	0.070 (0.068-0.073)
	Ant.V	0.110 (0.109-0.113)
	Ant.VIb	0.039 (0.034-0.043)
	PT	0.020 (0.018-0.022)
	URS	0.088 (0.086-0.092)
	HTB	0.557 (0.539-0.571)
No. of setae on	2HT	0.125 (0.118-0.134)
	Ant.I	4 (3-6)
	Ant.II	9 (8-12)
	Ant.III	9 (6-11)
	Ant.IV	6 (2-9)
	Ant.V	14 (13-15)
	URS	15 (12-17)
Ratio	Cauda	2 (2-4)
	Ant. / BL	0.326 (0.323-0.332)
	PT / Ant.VIb	0.518 (0.418-0.588)
	URS / BL	0.326 (0.323-0.332)
	URS / 2HT	0.711 (0.641-0.779)



**Fig. 1.** Embryo of *Tetraneura triangula*. A, whole body; B, Ant.; C, hind tarsus; D, URS; E, wax gland; F, cauda.



**Fig. 2.** Emigrant of *Tetraneura triangula*. A, whole body; B, fore wing; C, Ant.; D, Ant. IV to Ant. VI; E, URS; F, hind tarsus; G, GP.





Fig. 3. Galls of *Tetraneura triangula* on *Ulmus davidiana* var. *japonica*

**Materials examined.** 6 emigrants, Donghae-si, Gangwon-do, Korea, 19.v.2019, Coll JE-193 on *Ulmus* sp., J.E. Lee, GNU; 3 embryos, Donghae-si, Gangwon-do, Korea, 19.v.2019, Coll JE-193 on *Ulmus* sp., J.E. Lee, GNU; 5 embryos, Namwon-si, Jeollabuk-do, Korea, 21.v.2021, Coll HE-45 on *Ulmus davidiana* var. *japonica*., H.B. Lee, GNU.

**Host plant.** *Ulmus* sp., *Ulmus davidiana* var. *japonica* (Ulmaceae), *Echinochloa crusgalli*, *Hemistepta carthamoides*, *Imperata cylindrica*, *Phragmites communis*, and *Sorghum bicolor* (Poaceae) (Zhang et al., 1991).

**Distribution.** Korea (new record), China, and Japan.

**Diagnosis. Emigrant.** This species is closely related to *Tetraneura akinire* and *Tetraneura ulmi* but can be distinguished by having 8-10 hairs on Ant.II (*T. akinire*, 2-7 hairs; *T. ulmi*, 2-6 hairs).

### Key to The Species of the Genus *Tetraneura* from Korea

1. Hind tarsal claws in embryos inside emigrants not enlarged (0.055 mm long or shorter) ..... 2
- Hind tarsal claws in embryos inside emigrants enlarged (0.060 mm long or longer) ..... 7
2. SIPH present ..... *T. yezoensis*

- SIPH absent ..... 3
3. Head capsule with more than 50 hairs ..... *T. radicolica*
- Head capsule with less than 50 hairs ..... 4
4. Ant.II hair more than 8 (8-10) and head capsule with more than 40 hairs (46-49) ..... *T. triangula*
- Ant.II hair less than 8 and head capsule with less than 40 hairs ..... 5
5. Ant./BL less than 0.333 (0.278-0.325) and 32-36 hairs on gonapophyses ..... *T. ulmi*
- Ant./BL 0.333 more than 0.333 (0.033-0.440) and 18-32 hairs on gonapophyses ..... 6
6. Body length more than 1.400 mm ..... *T. pumilae*
- Body length less than 1.400 mm ..... *T. irienseis*
7. Ant.III with more than 10 hairs and 20-32 secondary rhinaria ..... *T. polychaeta*
- Ant.III with less than 10 hairs and 7-23 secondary rhinaria ..... 8
8. Head hair number more than 23 (23-31) and 18-30 smaller hairs and 4 long hairs on gonapophyse ..... *T. akinire*
- hair number less than 23 (17-22) and 4-12 long hairs on gonapophyses ..... *T. sorini*

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## Statements for Authorship Position & Contribution

Lee, J.: Gyeongsang National University, Researcher; Designed the research, wrote the manuscript and examined specimens

Lee, H.: Gyeongsang National University, Student in Ph.D; Collected and examined specimens

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Lee, W.: Gyeongsang National University, Professor, Ph.D; Examined specimens and designed the research

All authors have read and approved the manuscript.

## Literature Cited

- Blackman, R.L., Eastop, V.F., 2000. Aphids on the world's crops. An Identification and Information Guide 2nd ed. The Natural History Museum, London, pp. 363-365.
- Hille Ris Lambers, D., 1970. Study of *Tetraneura* Hartig, 1841 (Homoptera, Aphididae), with descriptions of a new subgenus and new species. *Boll. Zool. Agr. Bachicolt.* 2, 31-63.
- Lee, W.K., Seo, H.Y., Hwang, C.Y., 1993. Taxonomic study on Pemphigidae (Aphidoidea; Homoptera) from Korea. *ASED.* 9, 237-249.
- Linnaeus, C., 1758. *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species cum characteribus differentiis, synonymis, locis.* Editio decima, reformata. Holmiae, p. 821.
- Matsumura, S., 1917. A list of the Aphididae of Japan, with description of new species and genera. *J. Sapporo Agric. Coll.* 7, 351-414.
- Okamoto, H., Takahashi, R., 1927. Some Aphididae from Corea. *Insecta Matsumurana* 1, 130-148.
- Saito, S., 1941. Classification of Japanese animals 9 (2-2). Tokyo, Sansendo Publ. Co., pp. i-ii, 1-14.
- Sasaki, C., 1899. *Nippon Nōsakumotsu Gaichū Hen.* [Manual of crop insect pests in Japan.], 202. Tokyo, Japan.
- Sasaki, C., 1904. A gall-forming aphid on *Ulmus parvifolia*. *Zool. Mag.* 193, 403-405. (in Japanese)
- Strand, E., 1929. Zoological and paleontological nomenclatorial notes. *Acta Universitatis Latviensis*, 20, pp. 1-29.
- Watanabe, T., Lee, W., Sano, M., Murakami, K., Akimoto, S.-I., 2022. Taxonomic revision of the *Tetraneura akinire* species group (Insecta, Aphididae, Eriosomatinae), with description of a new species and a correction of a nomenclatural confusion. *Zootaxa* 5183, 162-186.
- Zhang, G.X., Zhang, W.Y., Zhong, T.S., 1991. Studies on the genus *Tetraneura* Hartig, 1841 from China (Homoptera: Pemphigidae) with descriptions of new species and subspecies. *Sinozoologia* 8, 205-236.