

A new species of the genus *Trichagalma* Mayr from China (Hym.: Cynipidae)

Juli Pujade-Villar

Universitat de Barcelona. Departament de Biologia Animal
jpujade@ub.edu

Jingshun Wang

Beijing Forestry University. Key Laboratory for Silviculture
and Conservation of Ministry of Education
Beijing 100083, P.R. China
aywjs8@163.com

Anyang Institute of Technology. Anyang 455000. P.R. China



Manuscript received in October 2011

Abstract

A new species of oak gallwasp, *Trichagalma glabrosa* Pujade-Villar is described from Eastern China (province of Henan), known to induce galls on *Quercus variabilis* Blume. Only asexual females are known. Data on the diagnosis, distribution and biology of the new species are given. This new species presents characters related to *Trichagalma*, *Pseudoneuroterus* and *Cerroneuroterus*, and their affiliation with *Trichagalma* is commented.

Keywords: Cynipidae; oak gallwasp; *Trichagalma*; new species; China.

Resum. Una nova espècie del gènere *Trichagalma* Mayr de Xina (Hym.: Cynipidae)

Es descriu des de l'est de la Xina (província de Henan), una nova espècie cinípid de roure, *Trichagalma glabrosa* Pujade-Villar la qual indueix gales a *Quercus variabilis* Blume. Només les femelles asexuals són conegudes. S'esmenten els caràcters dignòstics, la distribució i biologia. Aquesta nova espècie presenta caràcters relacionats amb *Trichagalma*, *Pseudoneuroterus* i *Cerroneuroterus*, per la qual cosa es comenta la seva afiliació amb *Trichagalma*.

Paraules clau: Cynipidae; gala; *Trichagalma*; nova espècie; Xina.

Introduction

The Cynipinae are divided into two main trophic groups: the gall inducers (Aylacini, Diplolepidini, Eschatocerini, Pediaspidini, Cynipini and Qwaqwaiini), and the gall-associated inquilines (Synergini and Paraulacini). In China very few species of Cynipini and Synergini have been mentioned (Abe et al., 2007).

The Cynipini tribe (oak-cynipid) induce galls on Fagaceae (mostly *Quercus*, but also *Castanea*, *Chrysolepis* and *Lithocarpus*) and some genera of Synergini can develop in Cynipini galls (*Ceroptres*, *Saphonecrus*, *Synergus* and probably also *Ufo*).

The oak gallwasps (Cynipini) are by far the most species-rich group of gallwasps, with c. 1000 species in 25 genera worldwide (Csóka et al., 2005; Abe et al., 2007). In China, around 35 species of *Quercus* are known (Shu, 1999a; Linkuo & Tao, 1998), 125 of *Lithocarpus* (Govaerts & Frodin, 1998), 58 of *Castanopsis* (a close relative of Nearctic *Chrysolepis*) (Shu, 1999) and 4 *Castanea* (Shu, 1999b), but the gall-wasp fauna is poorly known in this area. According to Abe et al. (2007) only 5 species have been mentioned from China on oaks: *Andricus mairi* (Kieffer, 1906), *A. pseudoflos* (Monzen, 1954), *A. targionii* Kieffer, 1903, *Biorhiza nawai* (Ashmead, 1904) and *Trichagalma serratae* (Ashmead, 1904). Also, one species on *Castanea*: *Dryocosmus kuriphilus* Yasumatsu, 1951; this one is a serious pest of chestnut trees indigenous to China and was accidentally introduced into Japan, Korea USA and Europe (Abe et al., 2007).

In this study a new species of *Trichagalma* (*T. glabrosa* Pujade-Villar n. sp.) is described from Eastern China. This species has peculiar characters that merits discussion of its generic affiliation. The galls collected from *Q. variabilis* are very similar to *T. acutissimae* (Monzen, 1956) but the adults are very different. The morphological differences are commented here. Hence, two *Trichagalma* species are present in China: *T. serratae* and *T. glabrosa* Pujade-Villar n. sp.

Material and methods

We follow the current terminology of morphological structures (Liljeblad & Ronquist, 1998; Melika, 2006). Abbreviations for fore wing venation follow Ronquist & Nordlander (1989); cuticular surface terminology follows that of Harris (1979). Measurements and abbreviations used here include: F1–F12, 1st and subsequent flagellomeres; POL (post-ocellar distance) is the distance between the inner margins of the posterior ocelli; OOL (ocellar-ocular distance) is the distance from the outer edge of a posterior ocellus to the inner margin of the compound eye; LOL, the distance between lateral and frontal ocelli. The width of the forewing radial cell is measured from the margin of the wing to the Rs vein.

The SEM pictures were taken with a Stereoscan Leica-360 by Palmira Ros-Farré at a low voltage (700V) and without coating, in order to preserve the specimens.

The type material is deposited in **UB**, University of Barcelona, Spain (J. Pujade-Villar) and **PDL**, Pest Diagnostic Laboratory (the former Systematic Parasitoid Laboratory, SPL), Tanakajd, Hungary (G. Melika).

Results

Trichagalma glabrosa Pujade-Villar new species

(Figs 1-3)

Diagnosis. *Trichagalma glabrosa* Pujade-Villar n. sp. differs from all other *Trychagalma* species in to have a scarce pilosity in body and in mesoscutellum because it is margined. Closely related to *Trichagalma acutissimae*, because both species have not dark pigmented spots in forewings but, *T. glabrosa* has the head face smooth and shiny (rugose in *T. acutissimae*), mesoscutum shiny (with dis-

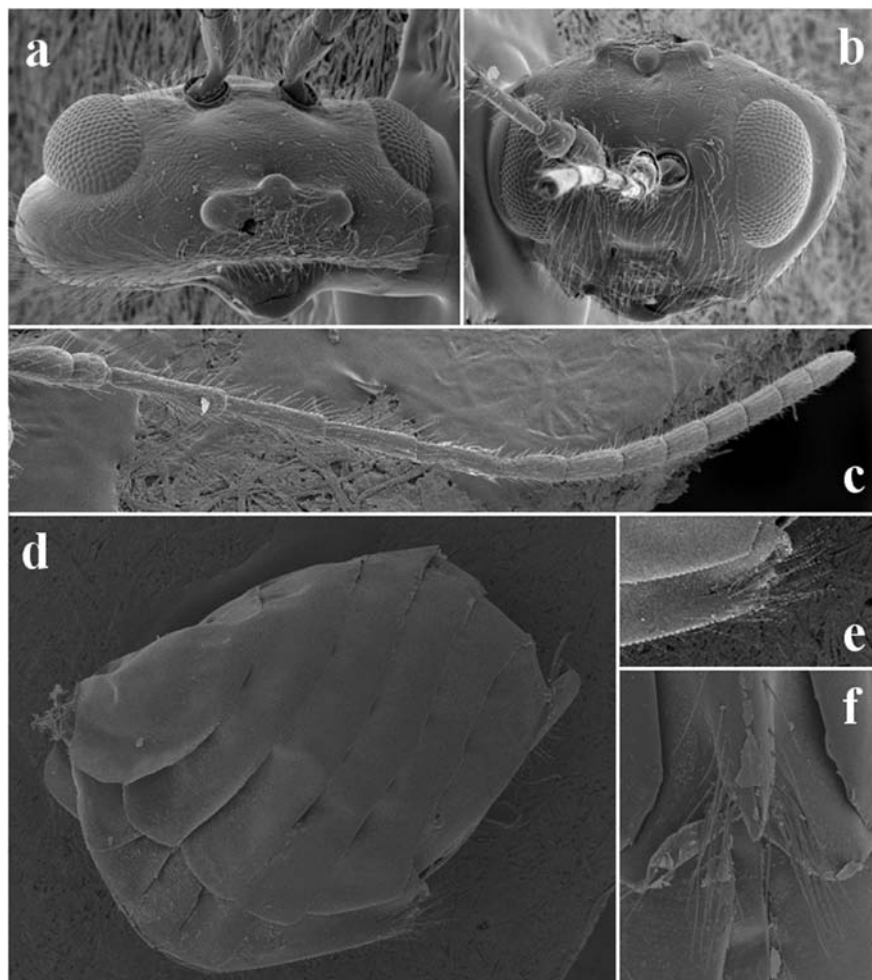


Figure 1. *Trichagalma glabrosa*, (a) Head in dorsal view, (b) head in frontal view, (c) antenna, (d) metasoma, (e) ventral spine in lateral view, and (f) ventral spine.

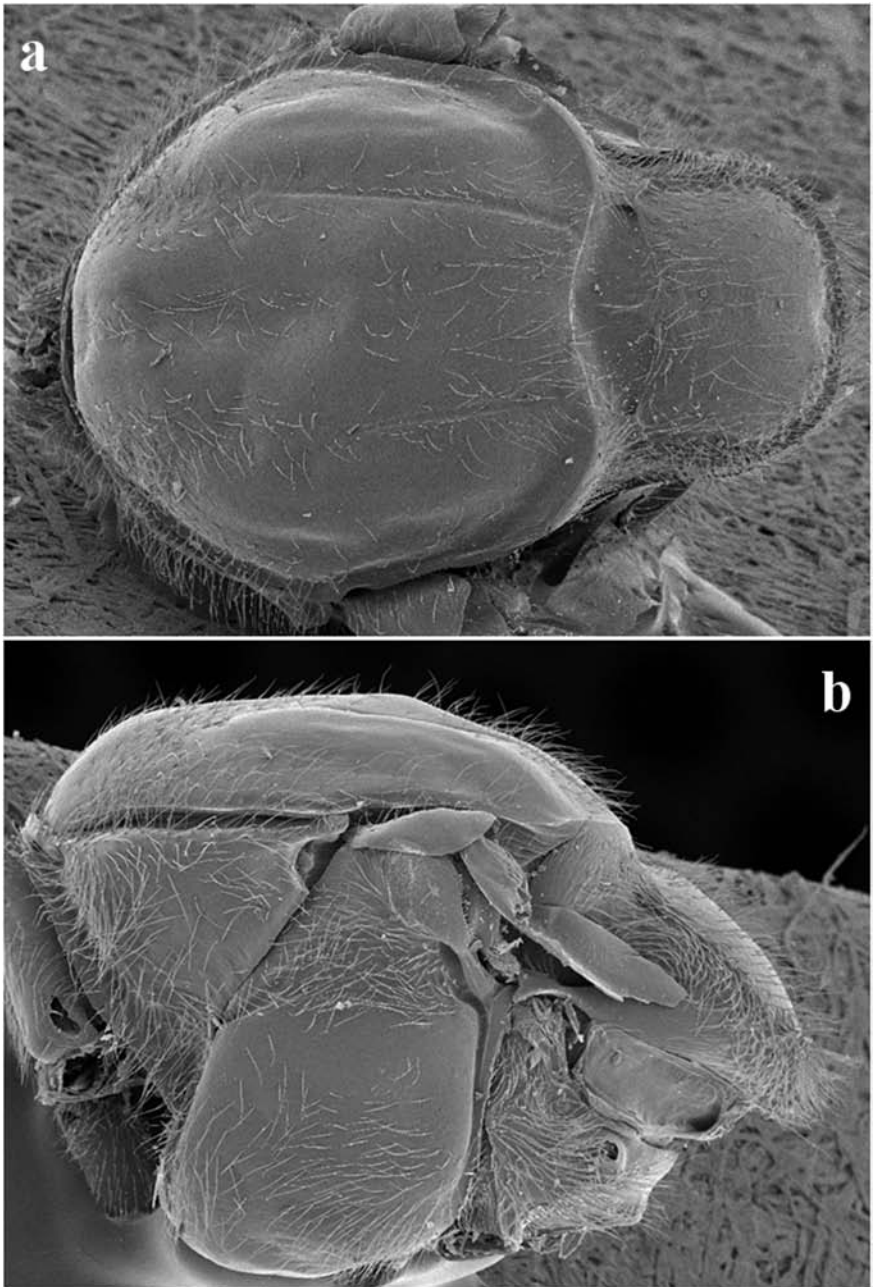


Figure 2. Mesosoma of *Trichagalma glabrosa*, (a) in dorsal view and (b) in lateral view.

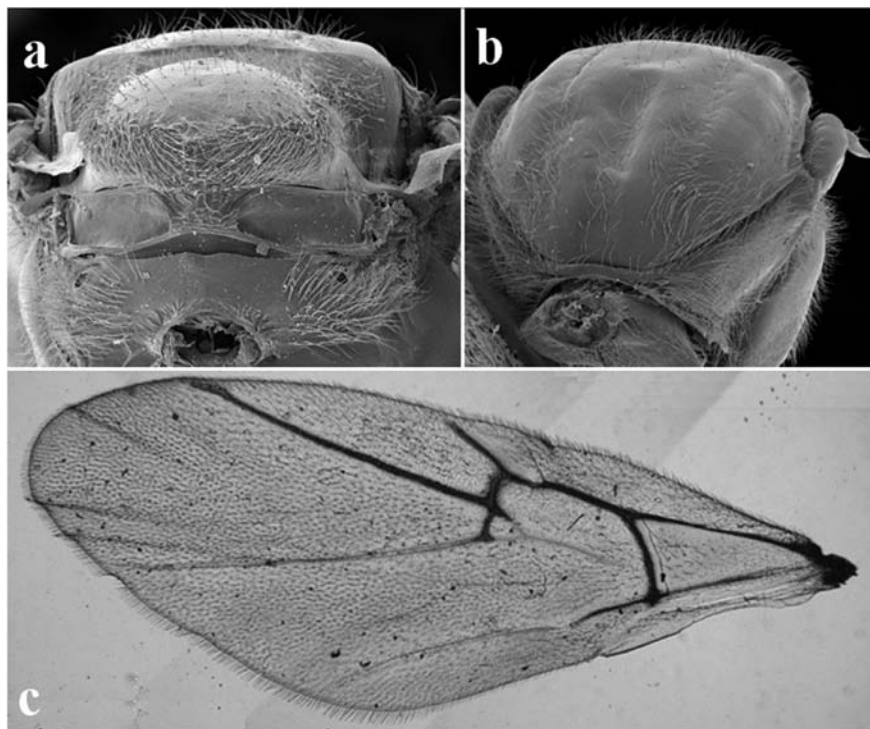


Figure 3. *Trichagalma glabrosa*, (a) propodeum area, (b) mesosoma in frontolateral view and (c) forewings.

tinct micropunctures especially between notauli in *T. acutissimae*) and mesoscutellum alutaceous with some areas almost smooth (uniformly rugose reticulate in *T. acutissimae*).

Description (asexual female).

Body length 3.2–3.8 mm (n=7).

Colour. Amber colored; occiput, margin of mandibles tooth and antenna dark brown; upper face and vertex, lateral and frontal part of pronotum, anterior and basal part of mesopleuron, stripes along anterior parallel and lateral parapsidal lines, scutellar foveae, preaxilla, lateral axillar area, axillula, metascutellum, propodeal area brown; body with sparse white setation; wing veins dark brown, without dark brown spots; legs amber colored, distal tarsi dark; metasoma amber colored with the proximal and distal parts brown (forming longitudinal bands).

Head. With uniformly sparse white setation. Face smooth and shiny, frons and vertex coriaceous. 2.5 times as broad as long from above; 1.4 times as broad as high in anterior view and wider than mesosoma. Gena alutaceous, broadened behind eye, shorter than cross diameter of eye (2:5). Malar space alutaceous,

0.3 times as long as height of eye, without striae and malar sulcus. POL 1.2 times as long as OOL; OOL 3 times as long as diameter of lateral ocellus, 1.6 times as long as LOL; lateral and frontal ocelli rounded, equal in length. Transfacial distance 1.3 times as long as height of eye and 1.8 times as long as height of lower face (distance between antennal rim and ventral margin of clypeus); diameter of antennal socket equal to distance between sockets, distance between socket and eye margin slightly longer than diameter of socket (3.5:3). Clypeus rectangular, flat, above 1.8 times as broad as high, coriaceous, with deep anterior tentorial pits, distinct epistomal sulcus and clypeopleurostomal lines; ventrally curved and not incised medially. Frons with deep smooth and shiny impression below median ocellus; vertex and occiput uniformly dull and coriaceous; interocellar area slightly elevated.

Antenna with 12 flagellomeres, longer than head+mesosoma; pedicel nearly as long as broad, F1 3.4 times as long as pedicel, 1.2 times as long as F2, F2 slightly shorter than F3, F4 slightly shorter than F3, F5 slightly shorter than F4; F6–F11 slightly shorter than F5 and equal in length; fused F12 1.5 times as long as F11; placodeal sensilla present in all flagellomeres. Ratio of antennal parts: 5:2.5:8.5:7:6.5:6:5.5:5:4:4:4:5:6.

Mesosoma longer than high in lateral view, with sparse white setation, mesoscutum pubescent. Pronotum shiny, weakly alutaceous laterally with some smooth areas and irregular wrinkles. Anterior rim of pronotum narrow, emarginate. Mesoscutum smooth and shiny, without punctures, with sparse setation, alutaceous anteriorly next to notaular areas; longer than broad (width measured across basis of tegulae); notauli incomplete, superficially impressed, not defined anteriorly; median mesoscutal line absent; anterior parallel and parapsidal lines not impressed. Transscutal articulation absent. Mesoscutellum margined, slightly longer than broad, 1.6 times shorter than length of mesoscutum, uniformly alutaceous and shiny, overhanging metanotum in lateral view; scutellar foveae absent, but indicated by a smooth depression, darker, broad and transverse area. Mesopleuron, including speculum, delicately smooth and shiny, with sparse white setation and a few weak punctures basally; mesopleural triangle weakly rugose, with sparse white setation. Metapleural sulcus reaching mesopleuron at 1/3 of its height; subaxillary bar narrow, smooth, shiny. Dorsellum slightly wider than high, uniformly delicately sculptured, ventral impressed area smooth and shiny; metanotal trough smooth, shiny, without setae. Lateral propodeal carinae absent, central propodeal area smooth, shiny, with central longitudinal delicate coriaceous carina, without setae; lateral propodeal area uniformly coriaceous, with white setae; nucha very short, with few delicate longitudinal sulci dorsolaterally and laterally.

Forewing longer than body; without dark brown veins and without dark irregular sclerotized pigmented spots; margin with very short, dense cilia; radial cell 3.8 times as long as broad, R1 on a short distance running along wing margin, Rs nearly reaching wing margin; areolet large, triangular, well-delimited by distinct veins; projection of Rs+M reaching basalis at lower third.

Legs. Hind tarsomeres I to V ratio as 1.0:0.4:0.2:0.13:0.46. Tarsal claws simple, without basal lobe.

Metasoma longer than head+mesosoma, slightly higher than long in lateral view, smooth, shiny, without setae; only 2nd metasomal tergites posterolaterally with a few white setae; 2nd tergite extending to 1/3 length of metasoma; prominent part of ventral spine of hypopygium extremely short, as long as broad ventrally, with dense long white setation, extending far beyond apex of spine; setae located only on lateral sides of ventral spine, absent ventrally.

Type material. HOLOTYPE female with the following labels: “CHINA, Linzhou (Anyang city, Henan province), 36°10'39.60''N 113°45'32.81''E, (03.vii.2010) 10.xii.2010, *Q. variabilis*, J. Wang leg.” (white label), HOLOTYPE *Trichagalma glabrosa* agam design. J.P-V 2011” (red label), “*Trichagalma glabrosa* J.P-V ♀ agam., det. 2011” (white label). PARATYPES (12 ♀): 12 ♀ with the same data as the holotype. Holotype and 8 paratypes UB, 4 paratypes PDL.

Gall (Fig. 4). The gall is spherical, smooth, 5.0–7.0 mm in diameter, pale yellow, red or brownish-red with minute bark spots, monolocular, with larval chamber in the center, mainly located on the front side of the leaf vein and with a few on the back side of the leaf of *Quercus variabilis* Blume. Galls begin to appear in May to early June; pupation takes place in October, and adults emerge from their galls in mid-November to December.

Host plant. *Q. variabilis* Blume (subgen. *Quercus*, section *Cerris*) distributed in Eastern China, Taiwan, Korea and Japan (Fig. 5).



Figure 4. Mature galls of *Trichagalma glabrosa* in leaves of *Q. variabilis* with details of immature stages.



Figure 5. *Quercus variabilis* distribution (made from the data presented in http://en.wikipedia.org/wiki/Quercus_variabilis, consulted 06.Set.2011) and *Trichagalma* species present in China: (a) *T. serratae* (Beijing province) and (b) *T. glabrosa* (Henan province). Map modified from http://es.wikipedia.org/wiki/Archivo:China_Henan.svg (consulted 06.Sep.2011).

Distribution. Only collected in Linzhou (Anyang city, Henan province, China). Galls very similar to *T. acutissimae* known only from Japan (Melika et al., 2010).

Biology. Only asexual (parthenogenetic) generation is known from galls on *Quercus variabilis*. Galls appear on the tree from early May. Under laboratory conditions, adults emerged in December, in nature they might overwinter in the gall and emerge in spring of the following year. Galls fall with the leaves. Common, although infestation by inquiline and parasitoids is quite high, which strongly influences emergence of the cynipid gall inducer. Parasitoids belonging to *Torymus* sp. (Torymidae), *Eupelmus* sp. (Eupelmidae) and *Ormyrus* sp. (Ormyridae), and inquiline belonging to *Synergus* sp, have been reared from these galls.

Etymology. The name refers to the sparse pubescence compared to the other known asexual (parthenogenetic) *Trichagalma* species.

Discussion

The host of this new species, *Q. variabilis*, is an evergreen and deciduous oak (belonging to subgen. *Quercus*, section *Cerris*) distributed (Fig. 5) in Taiwan, Japan, Korea, China (provinces of Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Liaoning, Shaanxi, Shandong, Shanxi, Sichuan, Yunnan and Zhejiang) and Tibet (according to web page “Oaks of the world”, http://oaks.of.the.world.free.fr/quercus_variabilis.htm). On this oak, all known *Trichagalma* species (*T. serratae*, *T. acutissimae*, *T. formosana* and *T. glabrosa*) are present and two of them are also present on *Q. acutissima* Carruth. (*T. serratae*, *T. acutissimae*). Both oak species are morphologically very similar and they are closely related with hybrids being common (Shozo & Takahiro, 2005), so probably all *Trichagalma* can be found on both *Quercus* species. These oaks have a different ecological niche; *Q. acutissima* occurs at good conditions with high nutrients and moisture content, whereas *Q. variabilis* is present on dry soil or rock habitat (Kim et al., 2008); in addition, the distribution areas of both oak species are similar, but *Q. acutissimae* occurs from 100 to 2200 m with *Q. variabilis* located up to 3400 m (according to web page “Oaks of the world”, <http://oaks.of.the.world.free.fr/index.htm>).

Trichagalma have two morphological species groups: (i) with hyaline forewings (*T. acutissimae* and *T. glabrosa*) and with dark pigmented spots (*T. serratae* and *T. formosana*). The first group produce galls on leaves and the second on twigs.

Morphologically, the asexual (parthenogenetic) form of *Trichagalma* is distinguished by the following characters (Melika et al., 2010): body predominantly reddish brown with some areas darker, antenna black or dark brown; head and mesosoma with dense white setation; gena distinctly broadened behind eye; malar sulcus absent, but weakly sculptured; antenna with 12 flagellomeres (sometimes indistinct suture indicates F13), F1 longer than F2; mesoscutum delicately coriaceous; notauli very superficial, complete or very hardly traceable in anterior half or 1/3; transscutal articulation medially indistinct or absent; mesoscutellum always longer than broad, with parallel sides, never emarginate laterally and posteriorly, never trapezoid, uniformly reticulately rugose or coriaceous; scutellar foveae absent, instead anterior transverse depression present which is nearly in same plane as mesoscutellar disc, with same sculpture on bottom, not or only very slightly deeper than disk; propodeum bare, smooth, without lateral propodeal carinae; forewing margin with long cilia, without or with smoky dark pigmented spots; radial cell 3.5–4.5 as long as broad; metasoma strongly compressed laterally; prominent part of ventral spine of hypopygium very short, nearly as long as broad with some long subapical setae, which never form a tuft; tarsal claws simple.

The new species described here does not satisfy all *Trichagalma* diagnostic characters, nevertheless there are no doubts that *T. glabrosa* belongs to this genus. It differs from all known species in two characters: (i) the pilosity, that it is very scarce in this new species, and (ii) in mesoscutellum that is margined. Nevertheless, the shape of adults, the gall and the host of this new species are similar to *T. acutissimae* (only known from Japan).

According to Melika et al., (2010) the lectotype of *T. acutissimae* have lost the head, nevertheless, some material belonging this species was examined by authors because they mention “in this species, notauli are superficial, incomplete in the anterior 1/3 of the mesoscutum; the head is trapezoid, strongly transverse in anterior view, with the broadest part at the upper margin of compound eyes; the mesoscutum, especially between notauli, with distinct micropunctures; the mesoscutellum uniformly rugose reticulate, not emarginate around”. Some of these characters are not present in *T. glabrosa* (see diagnosis). On the other hand, the original description (Monzen, 1953) mentions that *T. acutissimae* has a rugose face (smooth in *T. glabrosa*) and the specimen's length is 2.7 mm (longer in *T. glabrosa*). From all this there is no doubt that *T. glabrosa* is a different species than *T. acutissimae*, although their galls are identical.

Finally, *T. glabrosa* superficially resembles members of the genus *Pseudoneuroterus* in the sculpture of the mesoscutum (shiny and smooth) and in the lower density of pubescence on head and mesosoma. Nevertheless, the new species does not belong to *Pseudoneuroterus* because it has notauli (absent, indicated with delicately coriaceous stripes or with rows of setae in *Pseudoneuroterus*), in length of the prominent part of the ventral spine of hypopygium (3.0 in asexual (parthenogenetic) forms of *Pseudoneuroterus*) and in colour (mesosoma black or dark brown, metasoma black or brown in *Pseudoneuroterus*). Also, *T. glabrosa* may seem similar to *Cerroneuroterus* in the margined scutellum. Nevertheless the new species differs in overall habitus, pilosity (although not as dense as in other species of *Trichagalma*, is much more abundant than in *Cenrroneuroterus*, specially in head and mesoscutellum) and notauli (superficial and incomplete in *T. glabrosa*).

Acknowledgments

We are very grateful to Palmira Ros-Farré (UB) for taking the SEM pictures. Also to Xianghong Wang (Lizhou Municipal Forestry Bureau) and Kunpeng Zhang (Anyang Institute of Technology) for their support in this study.

Bibliography

- Abe, Y.; Melika, G.; Stone, G.N. 2007. The diversity and phylogeography of cynipid gall-wasps (Hymenoptera: Cynipidae) of the Oriental and Eastern Palearctic Regions, and their associated communities. *Oriental Insects* 41: 169-212.
- Csóka, G.; Stone, G.N.; Melika, G. 2005. Biology, Ecology and Evolution of gall-inducing Cynipidae. In: Raman, A., Schaefer, C.W.; Withers, T.M. (eds.) *Biology, ecology and evolution of gall-inducing arthropods*. Science Publishers, Inc. Enfield, New Hampshire, USA, pp. 569-636.
- Harris, R. 1979. A glossary of surface sculpturing. State of California, Department of Food and Agriculture, Occasional Papers in Entomology 28: 1-31.
- Kim, H.-R.; Jeon, H.-M.; Kim, A.-J.; You, Y.-H. 2008. Ecological niche of *Quercus acutissima* and *Q. variabilis*. Korean J. Environ. Biol. 26(4): 385-391.
- Liljeblad, J.; Ronquist, F. 1998. A phylogenetic analysis of higher-level gall wasp relationships (Hymenoptera: Cynipidae). *Systematic Entomology* 23: 229-252.

- Liljeblad, J.; Nieves-Aldrey, J.L.; Naser S.; Melika, G. 2011. Adding another piece to the cynipoid puzzle: the description of a new tribe, genus and species of gall wasp (Hymenoptera: Cynipidae) endemic to The Republic of South Africa. *Zootaxa* 2806: 35-52.
- Linkuo, F.; Tao, H. (eds.) 1998. Higher plants of China. Volume 4. Qingdao Publishing House, China. Govaerts & Frodin, 1998.
- Melika, G. 2006. *Gall Wasps of Ukraine*. Cynipidae. *Vestnik zoologii*, supplement 21(1-2): 1-300, 301-644.
- Melika, G.; Pujade-Villar, J.; Abe, Y.; Tang, C.-T.; Nicholls, J.; Wachi, N.; Ide T. Yan; M.-M., Péñzes; Z., Csóka; G.; Stone, G. N. 2010. Palearctic oak gallwasps galling oaks (*Quercus*) in the section Cerris: re-appraisal of generic limits, with descriptions of new genera and species (Hymenoptera: Cynipidae: Cynipini). *Zootaxa* 2470: 1-79.
- Ronquist, F.; Nordlander, G. 1989. Skeletal morphology of an archaic cynipoid, *Ibalia rufipes*. *Entomologica Scandinavica. Supplementum* 33: 1-60.
- Shozo, H.; Takahiro, K. 2005. Discrimination of hybrids between *Quercus variabilis* and *Q. acutissima* by using stellate hairs, and analysis of the hybridization zone in the Chubu District of central Japan. *Journal of Phytogeography and Taxonomy* 53(2): 145-152.
- Shu, L. 1999a. *Quercus*. In: Wu, Z.Y.; Raven, P.H. (eds.). *Flora of China (Cycadaceae through Fagaceae)*. Vol. 4. Science Press (Beijing) and Missouri Botanical Garden Press (St. Louis) [370-380 pp.]. (Available on line: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=10338, consulted 02 IX 2011).
- Shu, L. 1999b. *Castanea*. In: Wu, Z.Y.; Raven, P.H. (eds.). *Flora of China (Cycadaceae through Fagaceae)*. Vol. 4. Science Press (Beijing) and Missouri Botanical Garden Press (St. Louis) [315-316 pp.]. (Available on line: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=105816, consulted 02 IX 2011).
- Shu, Z. 1999. *Castanopsis*. In: Wu, Z.Y.; Raven, P.H. (eds.). *Flora of China (Cycadaceae through Fagaceae)*. Vol. 4. Science Press (Beijing) and Missouri Botanical Garden Press (St. Louis) [317-333 pp.]. (Available on line: http://www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=105821, consulted 02 IX 2011).