

## GEA, FLORA ET FAUNA

# A new Mexican species (Hym., Cynipidae) inducing tuberous galls in twigs of oaks (Fagaceae)

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## Abstract

A new cynipid gallwasp species, *Andricus fusiformis* Pujade-Villar n. sp., is described from Mexico. This species is known only from asexual females and induces stem galls in young shoots of *Quercus obtusata*. Diagnosis, biology and distribution data of this new species is given. Diagnostic characters are illustrated.

**Key words:** Cynipidae, tuberous gall-wasp, *Andricus*, taxonomy, morphology, distribution, biology. Mexico.

## Resum

### Una nova espècie Mexicana (Hym., Cynipidae) inductor de gales en branques de roures (Fagaceae).

Es descriu de Mèxic una nova espècie de cinípid cecidògen, *Andricus fusiformis* Pujade-Villar n. sp. Aquesta espècie es coneix a partir de la seva forma asexual provocant gales a les branques joves de *Quercus obtusata*. Es donen dades referents a la diagnòsi, distribució i biologia d'aquesta nova espècie. S'il·lustren els caràcters diagnòstics.

**Paraules clau:** Cynipidae, gales tuberoses, *Andricus*, taxonomia, morfologia, distribució, biologia, Mèxic.

## Introduction

The tuberous galls induced by oak wasps are included in the Cynipini tribe (Cynipidae). These are located in the branches of oaks and more rarely in the roots. Usually they have an irregular appearance and are multilocular. The surface is finely wrinkled. The coloration is gray with green tones when young (similar to the color of the bark when fresh) and woody brown at maturity. Hymenoptera induce these galls which remain within it for several years. To obtain the adults from the harden tissues of the gall is very difficult, even for the emerging adults which sometimes die before emergence inside the gall. In addition, being so longly exposed, there are galls with a high rate of parasitism and inquilism, so the number of inducers adults is often scarce, very scarce or even nonexistent (when all inducing larvae have been attacked), making difficult the precise determination because of the absence of the inducer adult.

In the United States, northern Mexico, there are several species of different genera involved in the formation of this type of galls: *Andricus* Hartig, *Bassettia* Ashmead, *Callirhytis* Förster, and *Loxaulus* Mayr (Weld, 1957, 1959, 1960; Burks, 1979); they are located in branches, roots and / or trunks near the ground (Weld, 1921). In the Neotropical region highlig-

hts *Odontocynips* Kieffer (Pujade-Villar, 2008, Mediator *et al*, 2011) and *Zapatella* Pujade-Villar & Melika (Pujade-Villar, unpublished data). In Mexico (Pujade-Villar *et al*, 2012, 2013) only *Andricus* produces true tuberous galls, although *Loxaulus* Mayr may produce thin fusiform swellings on the branches of oaks (Pujade-Villar *et al*, 2014.).

The Mexican species that cause tuberous galls have been recently revised in Pujade-Villar *et al*, (2012, 2013). Different species produce very similar or the same galls, if the adult is not obtained, they cannot be identified. In previous studies, multiple tuberous deformations are pending of identification, precisely because no adults were obtained. One of them is described in this study which produced, unlike all known Mexican species, thick spindle galls on branches of *Q. obtusata*. After having collected them on multiple occasions finally in 2014 we obtained the first adults.

## Material and methods

Cynipid galls were collected in Mexico D.F from *Quercus obtusata* Humb. & Bonpl. which belongs to the *Quercus* section. The galls were preserved in aerated receptacles waiting for adults emergence. The reared adults were preserved in

70 % ethanol until the morphological study was done at the Barcelona University. We also examined the reared parasitoids and some galls without any emergences were dissected for inner examination.

This paper follows the current terminology of morphological structures (Liljeblad & Ronquist 1998; Melika 2006). Abbreviations for forewing venation follow Ronquist & Nordlander (1989), cuticular surface terminology follows Harris (1979). Measurements and abbreviations used include: F1–F12, first 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 (lateral-frontal ocellar distance) is the distance between lateral and frontal ocelli. The width of the forewing radial cell was measured from the margin of the wing to the Rs vein.

SEM images of the new species were taken with the field-emission gun environmental scanning electron microscope (FEI Quanta 200 ESEM) which was used for high-resolution imaging without gold-coating, in order to preserve the specimens. The wasp habitus and the forewing of the adult was photographed with a digital camera-21C INFINITYX attached to a compound microscope Zeiss Discovery V8; the program DeltaPix View AZ-Pro was used to combine the series of images obtained in one single image.

The type material of the new species is deposited in the J. Pujade-Villar (JP-V) collection at the University of Barcelona (UB, Spain).

## Results

### *Andricus fusiformis* Pujade-Villar n. sp. (Figs 1–3)

#### Type material

HOLOTYPE ♀ with the following labels: “R106: MEX, San Juan Coajomulco (Jocotitlan, México), Ex. *Q. obtusata*, (19.vi.2014) 23.vi.2014, (leg. Delia)” (black label); Holotype of *Andricus fusiformis* Pujade-Villar n. sp. Desig. JP-V 2014” (red label). PARATYPE: “R115: MEX, San Juan Coajomulco (Jocotitlan, México), Ex. *Q. obtusata*, (12.vii.2014) 14.vii.2014: 1 ♀ (Leg. Delia)” (black label); Paratype of *Andricus fusiformis* Pujade-Villar n. sp. desig. JP-V 2014” (red label). Type material deposited in JP-V collection.

#### Additional material (2♀)

1 ♀ with the same data of Holotype (extracted) and 1 ♀ with the same data of Paratype (extracted).

#### Diagnosis

This new species belongs to the *Andricus* tuberos galls group, which has metasomal terga completely pubescent and forewings ciliated in margin as *A. furnaceus* Kinsey, 1920; *A. guanajuatensis* Pujade-Villar, 2013; *A. tumeralis* Pujade-Villar, 2009; *A. montezumus* Beutenmüller 1913 and *A. dugesi* Beutenmüller, 1917. Nevertheless, the new species differs from all these species by the mesoscutum sculpture. *Andricus fusiformis* Pujade-Villar n. sp. is the only species without

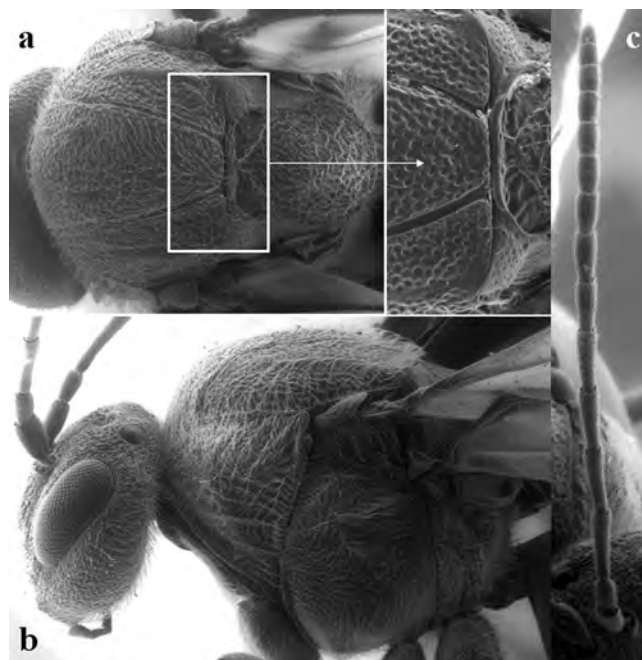


Figure 1. *Andricus fusiformis* n. sp.: (a) mesosoma in dorsal view and detail without setae, (b) head and mesosoma in lateral view and (c) antenna.

linear elements in mesoscutum, punctuated (with fine transverse and parallel carinae in *A. guanajuatensis* or, more or less strongly rugose in the rest of species mentioned). Also it has the metasoma punctuated, the lateral pubescence in a wide band and ventral spine of hypopygium long (6.0–7.0 times as long as broad).

#### Description

##### Asexual female

#### Length

Female: 3.5–3.6 mm (n=2).

#### Coloration

(Fig. 2d) black. Head brown, darker in lower face. Mesosoma black, with brown patches. Metasoma black, red-brown in the anterior third; hypopygium light. Legs dark, brown-black, coxae black. Vein of forewings brown.

#### Head

(Figs 1a–b) strongly coriaceous with dense white setae; transversally oval in frontal view, 1.3 wider than high; as broad as mesosoma; gena coriaceous with some carinae posteriorly, strongly broadened behind eye, 0.6 times as broad as cross diameter of eye, measuring along transfacial line; malar space 0.3 times as long as the height of the eye, coriaceous, without striae radiating from clypeus, malar sulcus absent; transfacial line similar to compound eye height. POL:OOL:LOL=8:3:3, diameter of lateral ocellus 2.0; 2.5 times as broad as long in dorsal view; lower face and frons without carinae; clypeus impressed, alutaceous, rounded ventrally, medially not incised, anterior tentorial pits distinct;

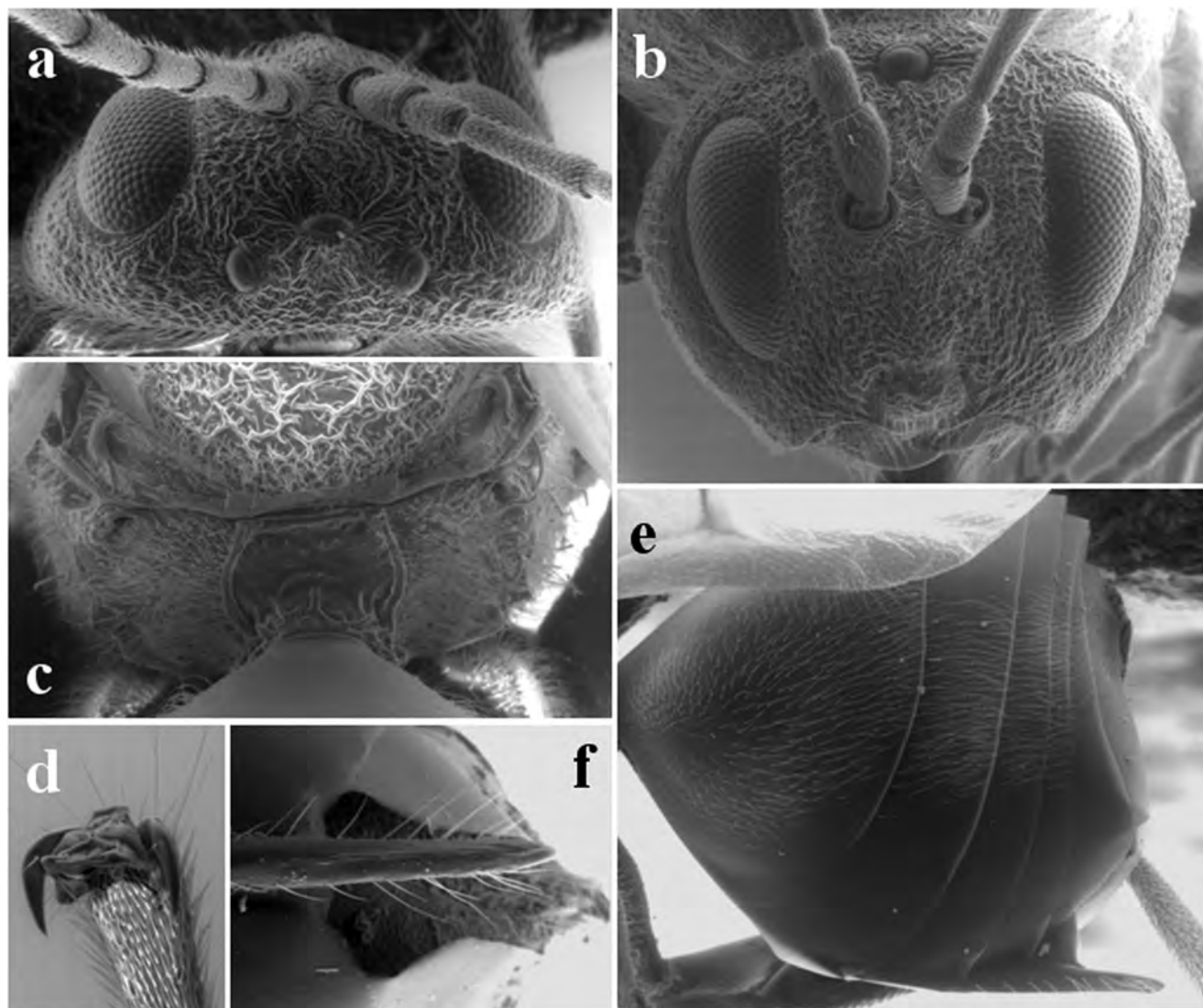


Figure 2. *Andricus fusiformis* n. sp.: (a) head in dorsal view, (b) head in frontal view, (c) propodeum, (d) tarsal claw, (e) metasoma in lateral view, and (f) ventral spine of hypopygium.

epistomal sulcus and clypeo-pleurostomal line distinctly impressed; striate radiating for clypeus present, but short and scarce, not reaching the base of the compound eyes and the malar space.

#### Antenna

(Fig. 2c) longer than length of head + mesosoma (42:28), with 12 flagellomeres; F1 slightly broader distally, subequal to F2; subsequent flagellomeres progressively shortened, F12 slightly longer than F11. Antennal formula: 6: 4(x2.5): 9(x3): 8.5: 8: 7: 6.5: 6: 5: 4: 4: 3: 4. Placodeal sensilla on F5–F12.

#### Mesosoma

(Figs 1, 2c) around 1.6 times longer than high, convex in lateral view. Sides of pronotum coriaceous with weak and parallel carinae in the lower 2/3 latero-posterior. Mesoscutum pubescent, broader than long in dorsal view; coriaceous, without linear elements, with piliferous points denser in the

posterior half; notauli complete, superficial anteriorly, narrow, reaching tegulae level, weakly converging posteriorly, median mesoscutal line absent; anterior parallel lines differentiated, alutaceous, present until tegulae level; parapsidal lines present, smooth, beyond tegulae level. Mesopleuron coriaceous, pubescent, with delicate and dense carinae, alutaceous and shiny without carinae posteriorly. Metapleuron sulcus differentiated reaching mesopleuron in 2/3 height. Mesoscutellum longer than broad, weak rugose and coriaceous; scutellar foveae differentiated, small, oval, superficial, with alutaceous bottom, widely separated and not delimited posteriorly by a carina. Lateral parts of propodeum uniformly alutaceous, densely pubescent; lateral propodeal carinae curved, central propodeal area nearly smooth and glabrous. Metascutellum subrectangular, alutaceous, strongly incised ventrally. Ventral bar of metanotal trough alutaceous; metanotal trough alutaceous, with sparse setae.



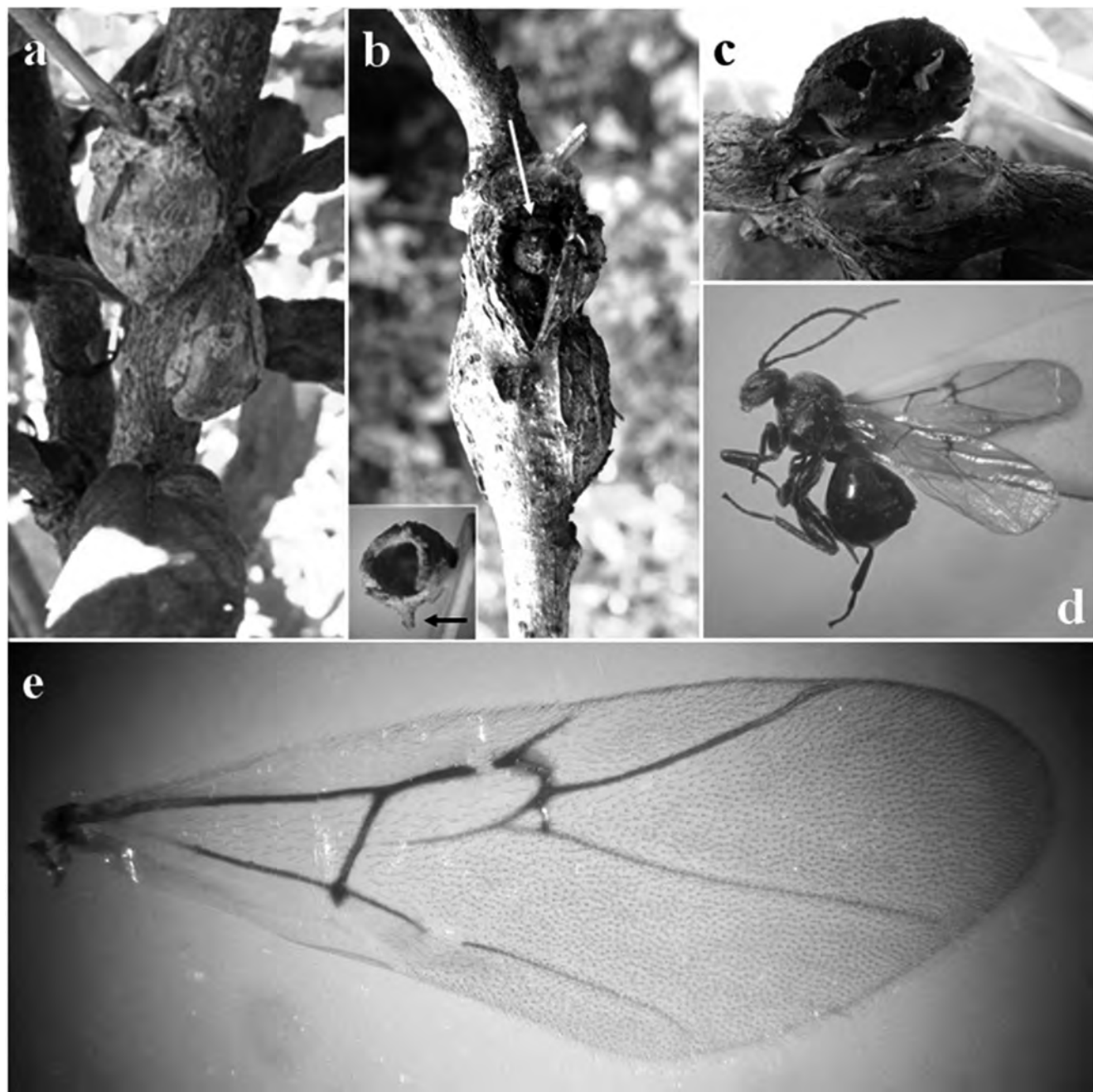


Figure 3. *Andricus fusiformis* n. sp.: (a) fresh gall, (b) gall cracked observing a larval chamber (see the arrow) and detail of larval chamber (the arrow indicates the petiole of the larval chamber), (c) fresh gall opened, (d) habitus and (e) forewing.

#### Forewing

(Fig. 3e) translucent, 1.2 times longer than body, pubescent, with cilia on margins; radial cell opened, around 4.0 times as long as broad; areolet present; Rs+M heading towards the middle of the basal vein, nearly reaching it.

#### Legs

(Fig. 2d) base of tarsal claws with strong tooth.

#### Metasoma

(Figs 2e–f) slightly shorter than head+mesosoma, longer than high. 2nd metasomal tergite with a lateral patch of white

setae, not punctate dorsally, all subsequent tergites uniformly and entirely punctate. Lateral pilosity forming a band. Prominent part of ventral spine of hypopygium needle-like, 6.0–7.0 times longer than broad, with sparse setae laterally which not form apical tuft in the apex.

#### Gall

(Figs 3a–c) galls are developing on thin branches of *Q. obtusata*. It is a plurilocular gall, woody, more or less fusiform (35–45 mm in length and 12–18 mm in diameter), composed by different subunits more or less fused. Coloration gray with green tones; adults emerge before the gall becomes hard and

Table 1. *Andricus* species producing tuberous galls, their host (including *Quercus* section) and state where these species have been collected.

<i>Andricus</i> tuberous galls species	<i>Quercus</i> species	Section	State
<i>A. bonanseai</i> Mayr	sp	¿?	unkown
<i>A. carrilloi</i> Pujade-Villar	<i>Q. rugosa</i> Née	<i>Quercus</i>	Zacatecas
	<i>Q. obtusata</i> Humb. & Bolpl.	<i>Quercus</i>	Morelos
<i>A. duguesi</i> Beutenmüller	<i>Q. castanea</i> Née	<i>Lobatae</i>	Guanajuato , Puebla
<i>A. durangensis</i> Beutenmüller	sp	¿?	Durango
<i>A. furnaceus</i> Kinsey, 1920	sp	¿?	San Luis Potosí
<i>A. guanajuatensis</i> Pujade-Villar	<i>Q. castanea</i> Née	<i>Quercus</i>	Guanajuato
	<i>Q. obtusata</i> Humb. & Bolpl.	<i>Quercus</i>	Querétaro
<i>A. fusciformis</i> n. sp.	<i>Q. obtusata</i> Humb. & Bolpl.	<i>Quercus</i>	Mexico
<i>A. montezumus</i> Beutenmüller	sp	¿?	unkown
<i>A. peredurus</i> Kinsey	sp	¿?	San Luis Potosí
<i>A. santafe</i> Pujade-Villar	<i>Q. laeta</i> Liebm	<i>Quercus</i>	Mexico DF
<i>A. tumefaciens</i> Pujade-Villar	<i>Q. chihuahuensis</i>	<i>Quercus</i>	Zacatecas
<i>A. tumeralis</i> Pujade-Villar	sp	¿?	Guanajuato

take a woody brown color. The surface is glabrous with some longitudinal grooves on the mature gall. The inner larval chambers are located in the internal tissues; when the gall is cracked we can observe the larval chambers inside the crack. The single larval chamber is globular (2.6 mm. of diameter), dirty yellow, with a hard woody wall (0.3 mm thick), which is connected with the tissue of the gall by a basal peduncle; at the top there is a small umbilicus.

#### Host plant

*Quercus obtusata* Humb. & Bonpl. (section *Quercus* of *Quercus*, white oaks), distributed in many states of Mexico at 620–2580 m a.s.l. (Valencia, 2004). Galls collected in branches of *Q. crassifolia* Humb and *Q. rugosa* Née in the same area of type material are similar but no adults have emerged; we cannot assure these galls are the same of collected in *Q. obtusata*, although all of them belong to the *Quercus* section.

#### Distribution

Currently known only from Mexico State. Galls were collected in San Juan Coajomulco (Jocotitlan).

#### Biology

Only the asexual (parthenogenetic) females are known. Galls develop in dry season and adults emerge in July. No parasitoids emerged, only *Synergus* on 24.vii.2014.

#### Etymology

The species name refers to the shape of gall.

## Discussion

Gallwasps from different genera that induce woody stem swelling-like galls on oaks -*Andricus*, *Bassetia*, *Callirhytis*, *Holocynips* *Loxaulus* and *Odontocynips*- are common in North and Central America. However, galls of different species and genera in stems, branches and twigs are quite different in size and shape. For example, *Bassetia* and *Loxau-*

*lus* induce galls in twigs without visible twig enlargements. Many *Callirhytis* species induce small spindle-shaped or club-shaped galls in twigs. Gall shape depends on the position of the twig: if terminal, the gall is club-shaped; if the gall is in the middle of the twig, then it is usually spindle-shaped. There is a smaller group of species belonging to *Andricus*, *Callirhytis*, *Dryocosmus*, *Eumayria*, *Holocynips* and *Odontocynips*, which induce large, tuberous galls on stems and twigs, commonly located in the tree crown or at the base of young sprouts (near or slightly underground surface), so-called «subterranean galls» (Weld, 1921). Tuberous galls are a phenotype extended among gallwasps, which have evolved independently several times in different phylogenetic unrelated groups. In the Neotropical area a tuberous gall produced by *Zapatella* (Pujade-Villar unpublished data) has been detected when these are usually restricted to *Odontocynips* in Panama and Costa Rica.

In Mexico 12 *Andricus* species produce tuberous galls (Table 1). Most of them, when the host is mentioned, are associated to white oaks. Only one species is found in red oak: *A. duguesi*. Nevertheless, 6 species belong to an unknown host (Table 1).

The species here described differs from all *Andricus* species with tuberous galls by morphology (see diagnosis) and by galls shape because it is the only species with fusiform tuberous galls in branches in Mexico. The North-American species *Andricus wheeleri* (Beutenmüller, 1907) has a similar morphology of *A. fusciformis* gall, nevertheless, the adults are completely different; in *Andricus wheeleri* the metasoma is scarcely pubescent on tergite II and the mesoscutum sculpture is strongly rugose (all metasoma terga pubescent and mesoscutum sculpture punctuated without linear elements in *A. fusciformis*).

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