

***Blumenavia toribiotarpaensis*: a new species of *Clathraceae*  
from Jalisco, Mexico**<sup>1</sup>YALMA L. VARGAS-RODRIGUEZ & <sup>2</sup>J. ANTONIO VÁZQUEZ-GARCÍA

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**Abstract**—A new stink horn species, *Blumenavia toribiotarpaensis* sp. nov. (*Clathraceae*) from Mexico, is described and illustrated. *Blumenavia toribiotarpaensis* differs from previously described species of the genus by its larger receptacle and basidiospores, distribution of the gleba over the upper half of the columns and presence of no more than four columns.

**Key words**—Basidiomycota, phalloid, systematics, Talpa de Allende

**Introduction**

During the course of studies of the distribution and demography of a recently discovered *Acer saccharum* subsp. *skutchii* (cloud forest sugar maple) population in Jalisco, Mexico (Vargas-Rodriguez 2005), we collected fungal specimens with novel features. A survey of the literature revealed that the specimens are an undescribed species of *Blumenavia* (*Clathraceae*).

The genus *Blumenavia* was established to accommodate *B. rhacodes* Möller (Möller 1895). Currently, two species, *B. rhacodes* and *B. angolensis* (Welw. & Curr.) Dring, are included in the genus (Dring 1980). The genus is characterized primarily by the small number of columns that lack transverse arms. In addition, the columns are free at the base and united at their apices with glebifers consisting of membranes attached by one side to each of the two inner angles of the column (Dring 1980, Sáenz 1980).

The new *Blumenavia* species occurs in a pine-cloud forest transition considered a Tertiary refuge (Vargas-Rodriguez 2005). The subtropical montane cloud forest is unique in having high plant species richness and includes a number of endangered and relict plants, comparable only to certain Asian forests (Graham 1999, Vargas-Rodriguez 2005). The forest contains temperate disjunct tree genera with East Asia and East North America, such as *Acer*, *Magnolia*, *Carpinus*, *Cornus*, *Fraxinus*, *Juglans*, *Tilia*, and *Ostrya* (Graham 1999, Vázquez-García et al. 2000). This exceptional community is proposed for protection as a biosphere reserve with 3,000 inhabitants supporting the movement

(Vargas-Rodriguez 2005). The discovery of the novel *Blumenavia* species increases our knowledge and relevance of the biota of this unique region.

### Materials and Methods

We collected fruiting bodies at different stages of development in a pine-montane cloud forest transition (1,800 m a.s.l.), near Talpa de Allende, Jalisco, Mexico, among fallen leaves under the canopy of adult *Pinus* spp. and *Carpinus caroliniana* trees. A second collection was made a year later in the same area and a third one in 2005. Five fruiting bodies were fixed in FAA solution (five parts 40% formaldehyde: five parts glacial acetic acid: 90 parts 95% ethyl alcohol) and seven were dried. A free hand cross section was made to one egg. Spores were mounted on slides in lactophenol and in 3% KOH and examined with a NIKON Microphot compound microscope using differential interference contrast and bright field optical systems. Hand-cut sections of the columns were made from a sample that had been fixed in FAA for nine months. Sections were dehydrated with ethanol, critical point dried, mounted, and coated with gold:palladium 60:40 in an Edwards S-150 sputter coater. We used a Cambridge S-260 scanning electron microscopy (SEM) for observation.

### Taxonomic Description

***Blumenavia toribiotalpaensis* Vargas-Rodriguez sp. nov.**

FIGS. 1-14

*Ovum fulvum, superficies interdum findens aquamis fulvis angularibus, elipsoidale 2.2-3.8 cm longum x 2.1-3.9 cm altum; adhaesae albae rhizomorphae 1-1.5 cm diametro. Receptaculum expansum 12.1-15.3 cm altum, 3.8-5.6 cm longum, colore vario ab albo ad dilutum bombax, cylindrale (or cylindratum) ex 3 vel 4 columnis robustis constans; columnis 0.9-1.1 cm diametro ex parte gracillima, 1.9-2.1 cm ex parte latissima, conjunctis superne, inferne liberis, cum sulco in superfacie; semicirculares sectione, constantes ex 9 tubis compositis in 3 ordinibus ab canali abaxiali; proximi canali sunt 5 tubuli circulares sectione in material nova; medius ordo constat ex 3 latioribus tubis, polygonalibus sectione; atque ex singulari magna polygonali tuba constat ordo extremus ab canali abaxiali. Columnae tela glebifera incrassata in facie interna informante cristam per anterior-laterales angulos columnae, glebifera incrassata marginibus unita, crista blebam ferente. Gleba coercita intra laceratam glebiferam cristam, sita in superior parte columnarum, atro-brunnescenti-olivacea, aroma simili piscibus mortuis et nauseosa. Basidiosporae 3.8-4.2 x 1.7-1.9  $\mu$ m. Associati basidiocarpis siti Scarabaei (Staphilinidae et Leiodidae) intra brachia et muscae (Tephritidae) in gleba maturorum basidiocarporum.*

Egg pale brown, outer surface sometimes cracking into angular brown scales, ellipsoidal, 2.2-3.8 cm wide, 2.1-3.9 cm high, gelatinous layer 5-7 mm thick, traversed by peridial sutures corresponding to each of the four columns, immature glebal mass about 4 mm diameter among columns, glebiferous tissue separated by a cavity opened in one extreme and joined to the column only by the opposite extreme, medullar zone rectangular-like in shape; attached white rhizomorphs 1-1.5 mm in diameter. Expanded receptacle 12.1-15.3 cm high and 3.8-5.6 cm wide, whitish to pale beige, cylindrical, with 3 to 4 robust columns; columns 0.9-1.1 cm diameter at the thinnest part to 1.9-2.1 cm at the widest part, united above, free below with a groove in the outer surface, semicircular in section,

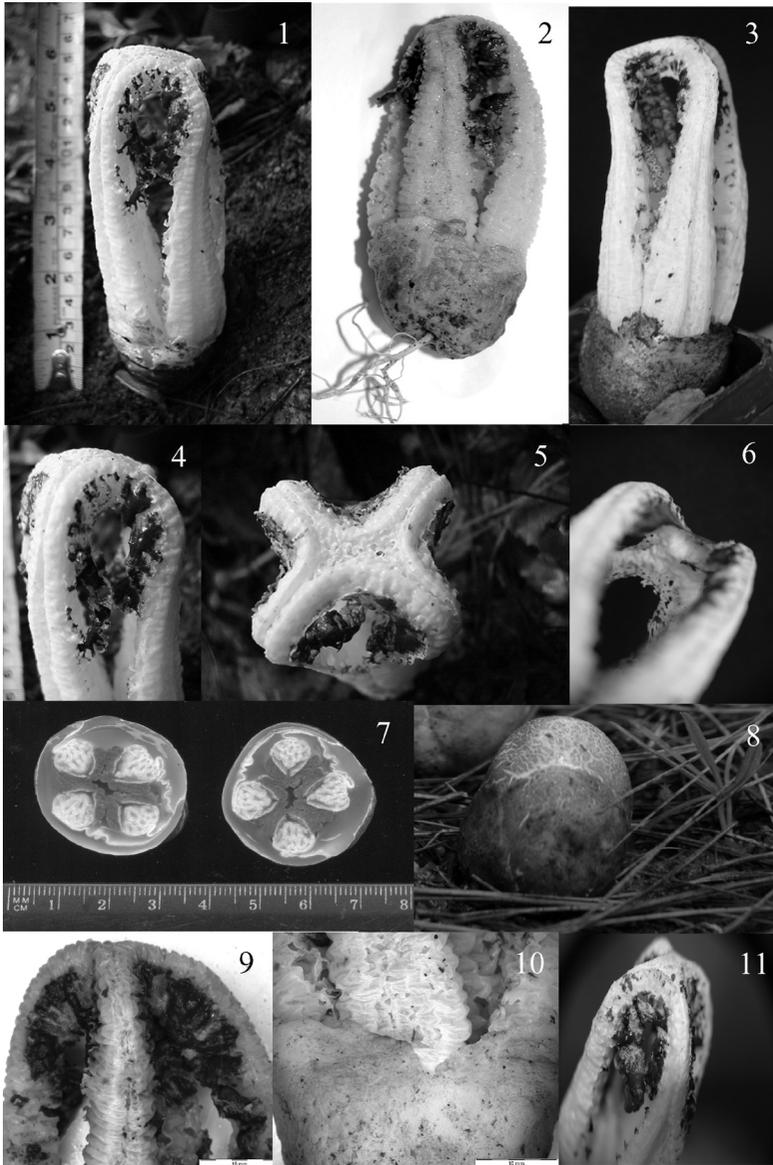


Figure 1-11. *Blumenavia toribiotalpaensis*, IBUG 422a. 1, Habitat photograph showing receptacle and volva. 2, Receptacle, volva, and rhizomorphs from specimen preserved in FAA. IBUG 456, 3, Receptacle and volva. IBUG 422a. 4, 5, 9, 10, Detail of gleba, showing its distribution over the upper half of the receptacle. IBUG 456, 6 & 11, Detail of gleba. Yalma L. Vargas-Rodriguez 455, 7 & 8. Freehand cross section of an egg. IBUG 422a, 9, Detail of the volva from specimen preserved in FAA.

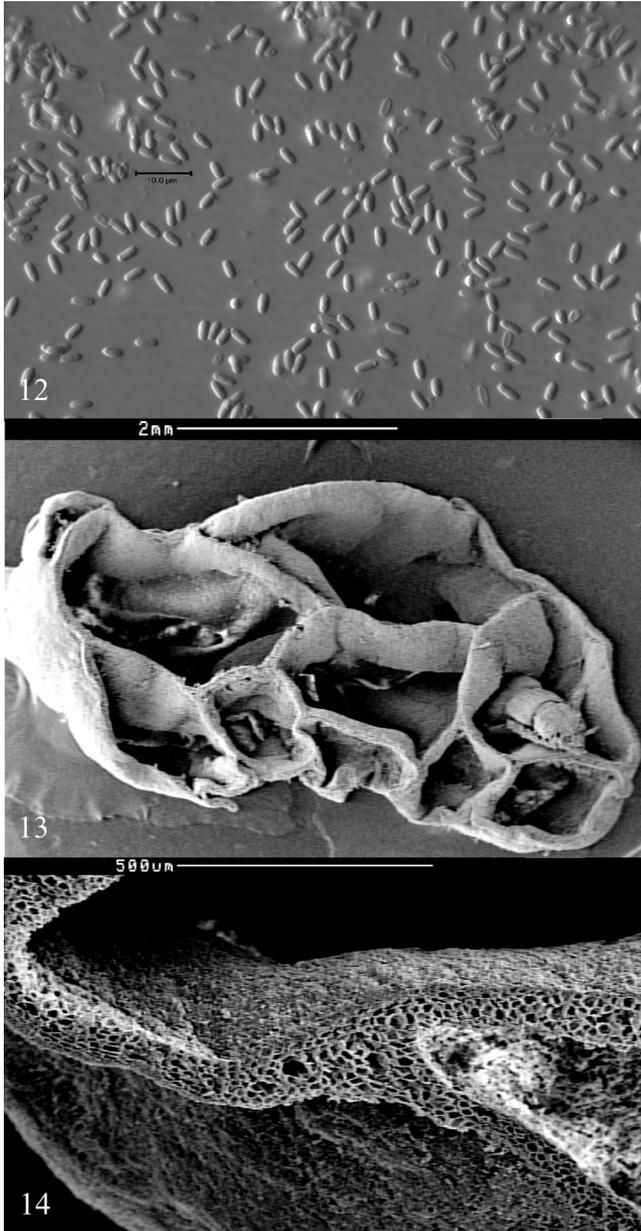


Figure 12-14. *Blumenavia toribiotalpaensis*, LSUM 422b. 12, Basidiospores. 13, Sections of the arm showing number and arrangement of tubes and associated staphylinid beetle. 14, Inner (upper side) and outer (bottom) arm surfaces.

comprised of 9 tubes arranged in three ranks from the abaxial groove; nearest to the groove are five small tubes, circular in section in fresh material; the middle rank consists of three wider tubes, polygonal in section; and a single, large polygonal tube comprises the outermost rank from the abaxial groove (Fig. 13). Columns with a thickened glebiferous tissue on the inner surface forming a crest along the anterior-lateral angles of the column, glebiferous tissue united to the arms by the edges, crest bearing the gleba. Gleba restricted to the lacerate glebiferous crest, situated on the upper half of the columns, dark olive-brownish, odor of dead fish, nauseous. Basidiospores 3.8-4.2 x 1.7-1.9  $\mu\text{m}$ , cylindrical, hyaline in KOH. Beetles [Staphilinidae (Fig. 13), Leiodidae] and flies (Tephritidae) associated with basidiocarps, beetles located inside the arms reach the interior through holes in basidiocarps, holes appear in decaying basidiocarps; flies located in gleba of mature basidiocarps.

**Specimen examined** — HOLOTYPE here designated. MEXICO, JALISCO: Talpa de Allende municipality, pine-cloud forest (*Acer-Podocarpus-Abies*) transition, “Ojo de Agua del Cuervo” (“Crow spring”) locality, west of Cumbre de Los Arrastrados (20°11’N; 105°16’W), 1800 m a.s.l., on *Pinus* spp. fallen trunk and debris, 10 Sep 2002, Yalma L. Vargas-Rodríguez 240, with Javier Curiel, J. Antonio Vázquez-García and Toribio Quintero Moro, dry specimen (BPI); 10 Sep 2002, Yalma L. Vargas-Rodríguez 240a, with Javier Curiel, J. Antonio Vázquez-García and Toribio Quintero Moro, dry specimen (IBUG) (Holmgren et al. 1990).

PARATYPE here designated. MEXICO, JALISCO: Talpa de Allende municipality, pine-cloud forest (*Acer-Podocarpus-Abies*) transition, “Ojo de Agua del Cuervo” (“Crow spring”) locality, west of Cumbre de Los Arrastrados (20°11’N; 105°16’W), 1800 m a.s.l., on fallen leaves of *Pinus* spp. and *Carpinus caroliniana*, 14 Sep 2003, Yalma L. Vargas-Rodríguez 422b, 423a, 423b, 424a and J. Antonio Vázquez-García, FAA preserved material (LSUM); 14 Sep 2003, Yalma L. Vargas-Rodríguez 422a and J. Antonio Vázquez-García, FAA preserved material (IBUG); 13 Sep 2005, Yalma L. Vargas-Rodríguez 454, 456, 462 and J. Antonio Vázquez-García, dry specimen (IBUG); 13 Sep 2005, Yalma L. Vargas-Rodríguez 459, 463 and J. Antonio Vázquez-García, dry specimen (LSUM).

**Etymology**—From the Latin *talpaensis*, referring to the municipality where the fungus was collected and *toribio*, referring to Toribio Quintero Moro, a remarkable forest conservationist. He has promoted the protection of the Talpa de Allende forests by collecting 3,000 signatures from Talpa de Allende habitants and petitioning state and federal Mexican authorities for the creation of a new biosphere reserve in the area.

**Known distribution**—Jalisco: Only known from the type locality. The species is not common in the area; individuals are patchy distributed along 100 m. The species was not previously known by local people. Only three other species (*Clathrus crispus*, *C. cancellatus*, and *C. ruber*) of the *Clathraceae* family are known for the Jalisco state and these do not co-occur with *Blumenavia toribiotalpaensis*. This is the first record of the genus for western Mexico and the second one for the country.

**Habit and habitat**—Occasionally gregarious. Among plant leaves and debris, under *Pinus* spp., *Carpinus caroliniana* and *Acer saccharum* subsp. *skutchii* canopy, in transitional pine forest to montane cloud forest.

## Discussion

*Blumenavia* differs from similar stink horn genera in the glebifer form. Especially notable is the unique gleba borne on lateral flaps of tissue that is lacking in *Clathrus*, *Laternea*, and *Ligiella*.

The differences between *Blumenavia toribiotarpaensis* and the two previously described species include the distribution of the gleba and the size of the receptacle and basidiospores (Table 1). The gleba is distributed along half the length of the column in *B. toribiotarpaensis*; in *B. rhacodes* the gleba is present over the entire length of the column and in *B. angolensis* restricted to the upper quarter or one third of the receptacle. The receptacle and basidiospores are larger in *B. toribiotarpaensis* than in the other two species (Table 1).

**Table 1.** Differences among species of *Blumenavia*

	<i>Blumenavia rhacodes</i>	<i>Blumenavia angolensis</i>	<i>Blumenavia toribiotarpaensis</i>
Expanded receptacle	8.5-13x8 cm	10x3 cm	12.1-15.3x3.8-5.6 cm
Receptacle color	Clear orange to yellow	White	Whitish to pale beige
Sections of columns; number of tubes	Triangular and trapezoidal; about 10 tubes	Subtriangular or quadrangular; about 6 tubes	Semicircular; 9 tubes
Number of columns	3-6	3-5	3-4
Groove along outer side of column	Present	Lacking	Present
Basidiospores	3-4x1-1.5 $\mu$ m	3-3.5x1.5 $\mu$ m	3.8-4.2 x 1.7-1.9 $\mu$ m
Gleba distribution	Entire length of the column	Upper quarter or one third of the receptacle	Upper half
Habitat and distribution	In coffee plantations in cloud forest in Mexico. Mexico: Veracruz; The Caribbean: Trinidad; South America: Brazil.	Habitat not noted. Africa: Angola, Tanzania, South Africa; US: Texas; The Caribbean: Puerto Rico; South America: Brazil.	Pine-montane cloud forest transition. Mexico: Jalisco.

Mature specimens of *B. toribiotarpaensis* usually have four columns but one immature specimen has only three. The white columns in fresh specimens separate *B. toribiotarpaensis* from *B. rhacodes* with orange-yellow columns; *B. angolensis* however, also has white columns. The spongy texture of the columns of *B. toribiotarpaensis* distinguishes this species from the more rigid, less spongy texture of *B. angolensis*. Number, shape and arrangement of tubes in transverse sections of columns differ, being more numerous in *B. toribiotarpaensis* than in *B. angolensis*, with a semicircular shape, and arranged differently from *B. rhacodes* (Table 1).

Habitat and known geographical distribution differ among the three *Blumenavia* species. Although both *B. toribiotarpaensis* and *B. rhacodes* are known from Mexico, *B. rhacodes* has been found in coffee plantations established under the canopy of cloud forest trees at 1300 m a.s.l. in Teocelo, Veracruz, Mexico (López et al. 1981), while *B. toribiotarpaensis* occurs at higher elevations (1800 m a.s.l.) in the transition of pine and cloud forest. In Mexico, *B. rhacodes* is also known from Xalapa, Veracruz (Calonge et al. 2004). This is the first record of the genus for western Mexico and is the second for the country, which was previously found in eastern Mexico (Veracruz state). Individuals of *Blumenavia* species have low density in Mexico. *Blumenavia angolensis* is known from Angola, Tanzania, South Africa and Brazil, although the habitats were not reported (Dring 1980) (Table 1).

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### Literature Cited

- Calonge FD, Guzmán G, Ramírez-Guillén F. 2004. Observaciones sobre los Gasteromycetes de México depositados en los herbarios XAL y XALU. Boletín de la Sociedad Micológica de Madrid 28: 337-371.
- Dring DM. 1980. Contributions towards a rational arrangement of the *Clathraceae*. Kew Bulletin 35: 1-96.
- Graham A. 1999. Late Cretaceous and Cenozoic history of North American vegetation. Oxford University Press, New York, New York, USA.
- Holmgren PK, Holmgren NH, Barnett LC. 1990. Index herbariorum. Part I. Ed. 8. Regnum Vegetation 120: 1-693.
- López A, Martínez D, García J. 1981. Adiciones al conocimiento de los Phallales del estado de Veracruz. Boletín de la Sociedad Mexicana de Micología 16: 109-116.
- Möller A. 1895. Botanische Mittheilungen aus den Tropen. Heft 7. Jena: G. Fisher, 152 pp.
- Sáenz JA. 1980. *Ligiella*, a new genus for the *Clathraceae*. Mycologia 72: 338-349.

- Vargas-Rodríguez YL. 2005. Ecology of disjunct cloud forest sugar maple populations (*Acer saccharum* subsp. *skutchii*) in North and Central America. Master of Science Thesis, Louisiana State University, Baton Rouge, Louisiana, USA.
- Vázquez-García JA, Vargas-Rodríguez YL, Aragon F. 2000. Descubrimiento de un bosque de *Acer-Podocarpus-Abies* en el municipio de Talpa de Allende, Jalisco, México. Boletín del Instituto de Botánica, Universidad de Guadalajara 7: 159-183.