Taxonomic notes on the genus *Endoxylina* (Diatrypales, Ascomycotina) and description of a new species from Mexico

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*Endoxylina tehuacanensis* is proposed as a new species in the Diatrypales (Ascomycotina). The specimens were collected upon fallen branches of *Acacia constricta* (Leguminosae) in the southeastern part of the state of Puebla, Tehuacan valley, Mexico. A description and illustrations of the morphological characters of this new species are provided. Moreover a brief review all species belonging to *Endoxylina* is presented.

**Key words:** *Endoxylina*, Mexico, new species.

**Introduction**

The Diatrypales comprise approximately 200 species (Hawksworth *et al.*, 1995) whose diversity is best represented by the genera *Eutypa*, *Eutypella*, *Diatrype*, and *Diatrypella* (26, 70, 56, and 32 species, respectively). Following these four genera are the less diverse *Cryptosphaeria* and *Leptoperidia* (4 species each), and *Dothideovalsa*, *Echinomyces*, and *Fassia* (3, 2, and 1 species, respectively).

Romell (1892) first proposed *Endoxylina* as part of the Diatrypales when he assigned *Eutypa astroidea* as the type species for this new genus (also see Müller, 1962; Mhaskar, 1972; Sivanesan, 1977; Rappaz, 1987; Ju Ming *et al.*, 1996). Historically, as many as 10 species have been assigned to *Endoxylina* (Sawada, 1959; Müller, 1962; Müller and von Arx, 1962; Mhaskar, 1972; Sivanesan, 1977), although some of these have since been transferred to other synonymous genera (Ellis and Everhart, 1892; Wehmeyer, 1975; Rappaz, 1987; Barr, 1993). This situation has led to a great deal of taxonomic uncertainty and nomenclatural instability, both for the genus and for the species that comprise it (Hawksworth *et al.*, 1995). In a recent attempt to resolve this problem, Ju *et al.* (1996) argued that the presence of cruciform ostioles on the perithecia, along with the characteristically dark, septate, oblong-allantoid spores, are sufficient reasons to ratify the genus *Endoxylina* within the order Diatrypales.
Notwithstanding the current agreement among specialists over the placement of *Endoxylina* within order Diatrypales, the number of species recognized for this genus is not well established. For example, Sivanesan (1977) discusses 9 of the 10 species of *Endoxylina* currently mentioned in the literature and, based upon ascospore morphology, separates these species into two main groups. The first group is defined by species having ellipsoid to fusoid or ovoid ascospores (4 species: *E. citricola* Ou, *E. dilabentispora* Farlow, *E. indica* Mhaskar and *E. mori* Sawada), and the second is comprised of species with cylindrical to allantoid ascospores (5 species: *E. pini* Sivanesan, *E. astroidea* (Fr.:Fr.) Romell, *E. anserina* (Pers.:Fr.) E. Müller, *E. crocea* Kisch and *E. polyspora* E. Müller). In addition, Shoemaker and Egger (1982) recorded *E. allantospora* (Ellis & Everh.) Shoemaker & Egger from Canada, which falls with little difficulty among the species with allantoid ascospores (Table 1). Sivanesan’s scheme clearly points out the importance of the ascospores in defining species groups. However, I would further suggest that variation in ascospore morphology is one of the principal causes for the frequent placement of *Endoxylina* among other genera. The presence of such characters as ovoid ascospores, marked septal constrictions (e.g., in *E. indica*), and multisporous asci (e.g., *E. polyspora*) suggest that at least 5 species, previously included among the *Endoxylina*, should be counted among genera such as *Valsa* and/or *Pseudovalsaria*. This topic certainly deserves greater attention. As a consequence a study of *Endoxylina* and similar genera is part of an ongoing investigation.

In this present study, a new taxon collected from the desert region of eastern central Mexico was easily placed within the *Endoxylina* because of several common characteristics, including: (1) darkly coloured spores, (2) flattened stromata, and (3) radially arranged openings along the ostioles of the perithecia. However, these typical morphological features were also accompanied by some unexpected characteristics, including: (4) large, triseptate spores, (5) asci with basal portions much shorter than the spore-bearing regions, and (6) the location of the perithecia in the cambium of the host. These unusual characters made it impossible to assign the Mexican material to any species previously ascribed to the genus. Accordingly, it seemed more likely that this material instead represented a new species of *Endoxylina*, which is formerly proposed and described below.

The Mexican material described herein as *Endoxylina tehuacanensis* came from the Tehuacán Valley, in the southeast-central region of Mexico, near Zapotitlán, Puebla. All samples were studied and deposited in the herbarium of the Instituto de Ecología (XAL) in Xalapa, Veracruz, Mexico. These specimens were also compared with generic and specific descriptions for
Table 1. *Endoxylina* species grouped according to ascospore morphology.

| Species with ellipsoid, subfusoid to ovoid ascospores | Species with cylindrical to allantoid ascospores  *
<table>
<thead>
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</tr>
<tr>
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<td><em>E. anserina</em> (Pers.:Fr.) Müller</td>
</tr>
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<td></td>
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</tr>
<tr>
<td></td>
<td><em>E. pini</em> Sivanesan</td>
</tr>
<tr>
<td></td>
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<td><em>E. tehuacanensis</em> sp. nov.</td>
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* modified of Sivanesan (1977)

*Endoxylina* species reported in the literature and personally counterchecked against holotypes on loan from other herbaria.

Also see Ju et al., in Mycotaxon 58, p.438, 1996.

Stromata extend broadly beneath the bark of the host plant and embedded in the host cambium; emerging as valsonid or eutypoid scabs or pustules, either separated or joined by a confluence; surface dark gray with blackish spots attributable to the ostioles of the perithecia. Perithecia globose to subglobose, separated by host tissue, rarely joined, and monostichous. Ostioles (tip of the perithecial necks) black, conical, papilate, surrounded by a mixture of fungal and host plant tissues not very prominent and emerging separately, the apical portion containing 3-5 linear sulcations arranged radially. Paraphysoid elements present, hyaline, and septate. Asci persistent, unitunicate, and octosporous, claviform, becoming thinner toward the base and terminating in a long, slender stipe; At times they are not so pronounced as is the case in the majority of species in this group; their apical pore is inamyloid. Ascospores oblong ellipsoid to allantoid, light to dark brown normaly symmetric but sometimes asymmetrics too; characteristically uni- to tri-septate; walls smooth and thick, regularly giving a false double-walled appearance.

*Endoxylina tehuacanensis* Chacón, sp. nov. (Figs. 1-5)

Stromata plerumque indeterminatus, plus minus 1-3 cm longus prolongatus ab portionis inferiore ex corticis hospitis et cambium inmersis, similis custra vel macula griseam, aspectus pulverulentus cum nigra punctata per ostiola, perithecia cum collum corticis perforatis. *Entostromata* crescaps pauci, quando adsum dein circa ad ostiola. *Perithecia* 400-570 x 400-450 μm, globosus, subglobosus, distantes vel subdistantes cretus aut aliquando conjunctim, monostichis. *Ostiola* (collum ad perithecia) 200-250 x 100-150 μm, pauci conspicua, emersum discreetus, portionis apicalis cum 3-4 fissurae linearis dispositionis radiata. *Asci* 60-80 x 11-15 μm in portionis fertilis, claviformis, apicis notabilis plus latus, basis terminatus in stipitatus
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<td><em>E. mori</em> Sawada</td>
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subtilis, non major ad longi ad portionis qui comprehendo sporarum, porus apicalis cospicuus, inamyloidea. *Ascospora* (17-)19-22(-23) × 5-6 μm, allantoideae vel subcylindricae, brunnea quasi nigra, crassitunicatus verisimiliter bitunicatus; triseptatus, aliquando uniseptatus et biseptatus, irregulariter biseriates intus ad asci.

In ramulus caducus ad *Acacia constricta* in vegetatio xerophilus.

*Stromata* regularly indefinite, 1-3 cm long, extending beneath the bark of the host plant and into the cambium, appearing as dusty- or grayish scabs flecked with darkish spots, which correspond to the ostioles of the perithecia (i.e. the perithecial necks that extend into the host bark). *Entostroma* dark gray and poorly developed, and when present, occurring around the ostioles. *Perithecia* measure 400-570 × 400-450 μm, globose to subglobose, separate or occasionally joined, monostichous. *Ostioles* 200-250 × 100-150 μm, not very prominent, emerging separately, apical portion characterized by 3-4 linear openings that are radially arranged. *Asci* 60-80 × 11-15 μm at fertile end, claviform, being markedly apically wider terminating in a thin stipe that is not greater in length than the portion of the ascus containing the ascospores, apical pore conspicuous, inamyloid. *Ascospores* (17-)19-22(-23) × 5-6 μm, allantoid to subcylindrical, brown to almost black in mass, having a thick wall, giving the appearance of a double walled structure, triseptate (occasionally only one or two septa are noted) and irregularly biseriate within the asci.

Habitat: Growing on fallen branches of *Acacia constricta* in xerophytic vegetation.

Material examined: MEXICO, Zapotitlan de las Salinas, Puebla, near the biological station operated by the Universidad Nacional Autonoma de Mexico (UNAM), 13 Dec. 1997, Chacón 5114-B (holotype); *ibid.* 17 Apr. 1999, Chacón 5127, 5136, UNAM Botanical garden, 12 June 1999, Chacón 5145 (all in XAL).

Other specimens examined: The following materials were compared with *E. tehuacanensis* and turned out to have great taxonomic affinity with this species. CANADA, *Cryptosphaeria eunomia* var. *fazini*; Ontario Ash, London; (NY-Ellis-holotype). SWITZERLAND, *Endoxylina astroidea* Roche, Vand; 5-3-1983, R-314 (in CBS as *Eutypa astroidea*; see also Rappaz, 1987). NORWAY, *Endoxylina anserina*; ukjent lokalitet; pa Tilia, Vertsplante: Tilia, Nils Green Moe [O-63083; as *Valsaria anserina* (Pers.:Fr.) Sacc.].

Notes: Among the characteristics that distinguish *Endoxylina tehuacanensis*, the most important are: (1) flat stromata, (2) perithecia embedded in the host cambium, (3) triseptate ascospores, and (4) allantoid ascospores larger than those observed in other species of this genus. Among morphologically similar representatives of other genera, the species most likely to be confused with it is *Cryptosphaeria eunomia* (Fr.:Fr.) Fuckel var. *fraxini* (Richon) F. Rappaz [which according to Ju Ming et al. (1996) should be included in the *Endoxylina*]. However, *C. eunomia* differs from *E. tehuacanensis* in having larger ascospores (16-30 × 4-6 μm), septa that vary from 1 to 3 to 5, and perithecia that develop separately, rather than growing together or being joined by a confluence. Of the species considered to belong
Figs. 1-5. Stereomicrograph, drawing and light micrographs of *Endoxylina tehuacanensis* (from holotype). 1. Partial view of the stromatic surface illustrating sulcate ostiola. 2. Vertical section through stroma illustrating perithecia and host tissue. 3. Asci and ascospores. 4. Drawing of the ascospores. 5. Ascospores. Bars: 1 = 0.4 mm; 2 = 400 μm; 3, 5 = 11.2 μm; 4 = 7.5 μm.

in *Endoxylina*, *E. citricola*, *E. dilabentispora*, *E. indica* and *E. mori* are herein rejected because they possess ellipsoid, fusoid, or ovoid ascospores, and they have only one septum (Table 1). Among species with allantoid ascospores (Tables 1, 2), *Eutypa astroidea* is characterized by stromata, asci, and
Table 2. A comparison of *Endoxylina* species with allantoid ascospores.

<table>
<thead>
<tr>
<th>Species</th>
<th>Ascospores</th>
<th>Asci</th>
<th>Perithecia</th>
<th>Stromata</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. allantospora</em></td>
<td>(11.4-)13-18(-21.6) μm with a single median septum, (occasionally forming a second septum)</td>
<td>83-117 × 8-14 μm. (probably stipe is included), octosporous, occasionally unisporous or bisporous</td>
<td>700-900 × 500-700 μm, flask shaped with a long neck, 1200 × 15-20 μm, in groups of 5-8</td>
<td>2-4 mm, scattered, deeply immersed, content white</td>
<td>Shoemaker and Egger, (1982)</td>
</tr>
<tr>
<td><em>E. anserina</em> *</td>
<td>16-20 × 6-7 μm, slightly constricted at the septum</td>
<td>Sporidia uniseriated inside asci</td>
<td>Scarce 500 μm, sphaeroid, gregarious but separated</td>
<td>Effuse, immersed, blakening the wood</td>
<td>Ellis and Everhart (1892) as <em>Valsaria anserina</em></td>
</tr>
<tr>
<td><em>E. astroidea</em></td>
<td>15-19 × 4-5 μm, unisepatate, not constricted at the septum</td>
<td>50-100 × 7-13 μm (only part with spores), octosporous</td>
<td>500-650 μm in diameter, sphaeroid, neck 350 μm in length</td>
<td>Immersed, scattered at the bottom of the bark</td>
<td>Rappaz (1987) as <em>Eutypa astroidea</em></td>
</tr>
<tr>
<td><em>E. crocea</em></td>
<td>10-14 × 2-3 μm, unisepatate, not constricted at the septum</td>
<td>50-70 × 6 μm, (probably stipe is included), octosporous</td>
<td>400-500 μm in diameter</td>
<td>Scattered in acervulous, more or less erumpent</td>
<td>Kirschstein (1935)</td>
</tr>
<tr>
<td><em>E. pini</em> *</td>
<td>13-15-17 × 2.5-3(-4) μm, one septate, rarely bisepatate, not constricted at the septum</td>
<td>50-60 × 6-7 μm (only part with spores, octosporous)</td>
<td>780 × 870 × 300-550 μm, neck 260-600 × 300-480 μm, in groups of 2-5</td>
<td>Immersed, in decorticated wood</td>
<td>Sivanesan (1977)</td>
</tr>
<tr>
<td><em>E. polyspora</em> *</td>
<td>7-9 × 2-3 μm, unisepatate, not constricted at the septum</td>
<td>60-70 × 10-12 μm, probably stipe is included, multisporous</td>
<td>200-300 μm, globose to piriform, isolate</td>
<td>Immersed to erumpent in isolate perithecia</td>
<td>Müller (1962)</td>
</tr>
<tr>
<td><em>E. tehuacanensis</em></td>
<td>(17-)19-22(-26) × 5-6 μm, trisepatate, not constricted at the septum</td>
<td>(60-)70-80 × 11-15 μm (part with spores) octosporous</td>
<td>400-570 × 400-450, globose, necks 200-250 × 100-150 μm, gregarious</td>
<td>Immersed in isolate to gregarious perithecia</td>
<td></td>
</tr>
</tbody>
</table>

* Currently under *Endoxylina*, need further study.
perithecia that are very similar to *E. tehuacanensis*. However, in *Eutypa astroidea* the ascospores are smaller (15-19 × 4-5 μm), having only one septum and their wall, while thick, does not give the appearance of a double-walled structure. Likewise, *Endoxylina allantospora*, *E. anserina*, *E. crocea*, *E. pini* and *E. polyspora*, show little affinity with *E. tehuacanensis* because they have uniseptate, allantoid ascospores that are also much smaller. Furthermore, it should be noted that: (1) the inferior portion of the asci of *Endoxylina tehuacanensis*, although narrower than the condition in other species examined, does not terminate in a filament characteristic of most species in this group; (2) the ascal pore, although conspicuous, is not as prominent as in *E. allantospora*; (3) the widest diameter of the ascus is slightly greater that that recorded for the known species of *Endoxylina*; and finally (4) the stromata of *E. astroidea* and *E. anserina*, although appearing very much like those in *E. tehuacanensis*, have more conspicuous perithecial ostioles, and consequently, have better defined apical openings.

Acknowledgements

Thanks are extended to the Instituto de Ecología, A.C., in Xalapa, Veracruz, for research facilities used during this investigation. Appreciation is also extended to B.M. Thiers (The New York Botanical Garden) and F. Rappaz (Institut de Botanique Systematique, Université de Lausanne, Suisse) for loaning valuable herbarium material. F. Rappaz is additionally acknowledged for reviewing the new Mexican specimens described in this study. J. Flores, of the Instituto Potosino de Investigación Científica y Tecnológica, A.C., is deeply appreciated for his unconditional support during field expeditions. Finally, thanks are extended to G. Carrión and V. Bandala of the Instituto de Ecología for critically reviewing the manuscript, and to D. Bennack for translating the original Spanish version of the article into English.

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