Two new *Entyloma* species (*Entylomatales*, *Ustilaginomycotina*) from the USA

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Abstract. Two new *Entyloma* species, *E. castillejae* on *Castilleja* (*Orobanchaceae*) and *E. violae* on *Viola* (*Violaceae*), are described and illustrated from the USA.

Key words: *Castilleja*, *Entyloma*, *Orobanchaceae*, smut fungi, taxonomy, USA, *Viola*

Introduction

Revision of *Entyloma* specimens from the herbarium of the Swedish Museum of Natural History, Stockholm (S) yielded two new species on host genera from which *Entyloma* had not been previously recorded.

The species of *Entyloma* form sori in vegetative organs (mostly in leaves, rarely in stems, occasionally in roots) of dicotyledonous plants, usually forming few to numerous spots, sometimes swellings or galls formed by hypertrophic growth of host tissue. The spores are permanently embedded in the host tissue, single or in irregular groups, hyaline, yellow or yellowish brown, usually with a smooth, two-layered wall, often with a hyaline gelatinous sheath; very rarely the outer layer is tuberculate (e.g., *E. verruculosum*) or with prismatic, pyramidal or coarse, irregular thickenings (e.g., *E. urocystoides*).

Entyloma comprises about 180 species on host plants belonging to 25 families (Vánky 2013). There are 47 species known from the USA: *E. achilleae* Magnus, *E. agoseridis* Zundel, *E. anceps* Cif., *E. arnicale* Ellis & Everh., *E. asteris-sericeae* Zundel, *E. australe* Speg., (?) *E. bidentis* Henn., *E. boltoniae* Cif., *E. calendulae* (Oudem.) de Bary, *E. clintonianum*

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Zundel & Dunlap, *E. collinsiae* Harkn., *E. compositarum* Farl., *E. dahlia* Syd. & P. Syd., *E. davisii* Cif., *E. echinaceae* Vánky & McKenzie, *E. ellisii* Halst., *E. erigerontis* Syd. & P. Syd. ex Cif., *E. eschscholziae* Harkn., *E. eupatorii* Cif., (?) *E. ficariae* A.A. Fisch. Waldh., *E. fimbriatum* G.W. Fisch., *E. floerkeae* Holw., *E. fuscum* J. Schröt., *E. gaillardianum* Vánky, *E. gratiolae* (Davis) Cif., *E. guaraniticum* Speg., *E. heterothecae* Vánky, *E. hieracii* Syd. & P. Syd., *E. holwayi* P. Syd., *E. lapponicum* Liro, *E. lepachydis* Cif., *E. linariae* J. Schröt., *E. lithophragmatis* G.W. Fisch. & C.G. Shaw, *E. lobeliae* Farl., *E. madiæ* Cif., *E. martindalei* (Peck) Piątek, *E. meliloti* McAlpine, *E. menispermi* Farl. & Trel., *E. microsporum* (Unger) J. Schröt., *E. polysporum* (Peck) Farl., *E. saccardianum* Scalia ex Cif., *E. saniculae* Peck, *E. serotinum* J. Schröt., *E. thalictri* J. Schröt., *E. trigonellae* J.A. Stev., *E. veronicae* (Halst.) Lagerh., and *E. winteri* Linh. (Vánky 2011; Farr & Rossman 2013). However the available specimens of *Entyloma* from the USA need revision because the scientific literature indicates that there are many fungus-host combinations that do not correspond to the modern taxonomic concept of this genus (Vánky 2013).

Material and methods

Dried specimens from the mycological collection of S were examined under light (LM) and scanning electron (SEM) microscopes. For LM observations, spores were mounted in lactophenol solution on glass slides, gently heated to boiling point to rehydrate the spores, and then cooled. Spore measurements are given in the form: min–max (extreme values) [mean $\pm$ 1 standard deviation]. For SEM, spores were attached to specimen holders by double-sided adhesive tape and coated with gold with an ion sputter. The surface structure of spores was observed at 10 kV and photographed with a JEOL JSM-5510 scanning electron microscope.

Taxonomy

Entyloma castillejae T. Denchev, Denchev & R.G. Shivas, **sp. nov.**
IF 550279

Figs 1–4

Differs from all other *Entyloma* species by specialisation on *Castilleja*.

Type in leaves of *Castilleja* sp.: USA, Colorado, Gothic Biol. Station, 14 July 1931, B. Palm (**holotype**, S F157 103).

Etymology: the name refers to the host species.

Sori in leaves, forming irregularly rounded spots, single to few in an infected leaf, amphigenous, 0.5–3 mm in length, usually between the veins, brownish. **Spores** embedded in leaf tissue, crowded, globose, subglobose, broadly ellipsoidal or slightly irregular, (8.5–)9.5–14.5(–16.0) $\times$ (8.0–)9.0–13.5 [12.1 $\pm$ 1.2 $\times$ 11.1 $\pm$ 1.2] μ m (n = 100), subhyaline to light yellow-brown; wall two-layered, inner layer evenly thickened, 0.6–0.8 μ m thick, light yellow-brown, outer layer slightly uneven, 1.0–1.7(–2.0) μ m thick, subhyaline, smooth, in old spores sometimes ruptured; in SEM the spore surface rough. **Anamorph** present.

Distribution: on *Castilleja* (*Orobanchaceae*), known only from the type locality.

Figs 1–4. *Entyloma castillejae* on *Castilleja* (holotype). 1. Leaf spots. 2–3. Spores in LM. 4. Spores in SEM. Scale bars: 1 = 1 mm, 2–3 = 10 μm , 4 = 5 μm

An *Entyloma* species on a member of *Castilleja*, *C. miniata* Douglas ex Hook., has been recorded only from Washington, USA (Shaw 1973) without assignment to a particular species.

In the traditional classifications, *Castilleja* was placed in the *Scrophulariaceae* (e.g., Cronquist 1981). However, numerous molecular systematic studies have demonstrated that *Scrophulariaceae*, as it is traditionally recognised, represents polyphyletic assemblage of taxa comprising more than seven distinct lineages of *Lamiales* (Tank *et al.* 2009). Currently, *Castilleja* is treated as belonging to the *Orobanchaceae*. There are no *Entyloma* species on plants in the *Orobanchaceae*.

Entyloma violae T. Denchev, Denchev & R.G. Shivas, **sp. nov.**

Figs 5–8

IF 550280

Differs from all other *Entyloma* species by specialisation on *Viola*.

Type in leaves of *Viola* sp.: USA, Colorado, Gothic Biol. Station, 1931, B. Palm (**holotype**, S F157 094).

Etymology: the name refers to the host species.

Sori in leaves, forming rounded spots, scattered, amphigenous, 0.5–3.5 mm in diam., initially yellowish green, later yellowish brown, paler on the margins, on the upper leaf surface becomes purplish with age (Fig. 5); not limited by veins, slightly protruding or flat. **Spores** embedded in leaf tissue, globose, subglobose or slightly irregular, (9.5–)10.0–15.5(–16.5) × (8.5–)9.5–15.0 [$13.3 \pm 1.3 \times 12.3 \pm 1.2$] μm ($n = 100$), hyaline to subhyaline; wall two-layered, inner layer evenly thickened, 0.6–1.0 μm thick, outer layer slightly uneven, 0.9–2.0(–2.3) μm thick, smooth; in SEM the spore surface smooth. **Anamorph** present.

Distribution: on *Viola* (*Violaceae*), known only from the type locality.

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Figs 5–8. *Entyloma violae* on *Viola* (holotype). 5–6. Leaf spots (on the upper side and underside, respectively). 7. Spores in LM. 8. Spores in SEM. Scale bars: 5–6 = 1 mm, 7 = 10 μm , 8 = 5 μm