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FULL PAPER

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Entyloma cosmi sp. nov. on *Cosmos bipinnatus* (Compositae)

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Abstract *Entyloma* species causing white smut disease of *Cosmos* species have been studied. Two species can be recognized, *Entyloma holwayi* on *C. caudatus* and *C. sulphureus* from North America, and *E. cosmi* sp. nov. on *C. bipinnatus* from Japan and Europe.

Key words *Cosmos* · *Entyloma* · *E. cosmi* · New species · Smut fungi

Introduction

More than 100 years ago, Holway repeatedly collected smutted leaves of *Cosmos sulphureus* Cav. in Mexico. The smut was named, described, and distributed by the Sydows in their exsiccata, Sydow, Ust. no. 282 (1901) as *Entyloma holwayi* Syd. & P. Syd.. The smut was also found in the USA, in Louisiana (Zundel, 1953) and collected by the senior author in Mexico in 2003, both on *Cosmos caudatus* Humb., Bompl. & Kunth and *C. sulphureus* (Vánky 2004a,b). In 2002, Jage collected some smutted leaves of *C. bipinnatus* Cav. in Germany. The fungus was identified as supposedly immature *E. holwayi* and published by Vánky et al. (2005). In recent years, the white smut (*Entyloma*) of *C. bipinnatus* has been one of the most severe plant diseases in Hokkaido, reducing the commercial value of fresh cut flowers (Horita and Haga 1998; Horita 2001).

Rich material, collected recently in Mexico, Japan, and Germany, permitted a detailed investigation of smutted *Cosmos* specimens and a comparison of their parasites. This work resulted in the recognition of a second, well-delimited *Entyloma* species, which is described here. Especially the presence of conidia on smutted *C. bipinnatus* and absence of these in North American specimens, was the reason for further investigations. In addition, Horita observed that although *C. bipinnatus* was severely infected, other *Cosmos* species (e.g., *C. sulphureus*, *C. atrosanguineus* (Hook.) Voss), growing in the same area, were free from infection.

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Materials and methods

Specimens examined: *Entyloma holwayi* Syd. & P. Syd. on *Cosmos sulphureus* Cav., Mexico, Chapala, 19.VII.1899, E.W.D. Holway, lectotype BPI 175509!, isolectotypes in Sydow, Ustilagineen no. 282, HUV 1040!; topotype on 5.X.1903, E.W.D. Holway, isotopotypes in Seymour & Earle, Econ. Fgi., Suppl. C. no. 108, HUV 9697! *E. holwayi*, Mexico, Nayarit State, 35 km NW of Tepic, alt. 184 m, 20.XI.2003, T. & K. Vánky, HUV 20523!, in Vánky, Ust. exs. no. 1204. *E. holwayi* on *Cosmos caudatus* Humb., Bompl. & Kunth, Mexico, Temixco State, Cuernavaca, Brisas, alt. 1290 m, 11.XI.2003, T. & K. Vánky, HUV 20524!, in Vánky, Ust. exs. no. 1203. *E. cosmi* Vánky, Horita & Jage on *Cosmos bipinnatus* Cav., Japan, Hokkaido, Takikawa, Higashi-takikawa, 30.IX.2004, H. Horita, holotype, HUV 20.935! *E. cosmi* on *C. bipinnatus*, Germany, Sachsen-Anhalt, Kreis Wittenberg, Kemberg, 24.VIII.2002, H. Jage 2596/02, topotype, HUV 20383!; ibidem, 3.VIII.2004, H. Jage 1402/04, paratype, HUV 20948!.

Small pieces of mature sori were cut out and placed on a microscope slide in a mixture of a droplet of lactophenol with cotton blue and several droplets of distilled water. The solution with the sori was heated two or three times to boiling point. Under a stereo microscope, the softened sori were cut into narrow pieces, squashed with a lancet, and covered with a cover glass. By gently heating to boiling point, air bubbles were eliminated from the preparation, which was then studied by light microscopy (LM) at 1000×

magnification. Teliospores were drawn with the aid of a camera lucida.

Results and species descriptions

Comparison of the sori, teliospores, and presence or absence of an anamorph of *Entyloma* species on various *Cosmos* species resulted in the recognition of two well-characterized *Entyloma* species, which are described and illustrated next.

1. *Entyloma cosmi* Vánky, Horita, & Jage, sp. nov.
A *Entylomate holwayi* Syd. & P. Syd (in Sydow, Ustilagineen no. 282, 1901) distinctum imprimis teliosporis majoribus, 9.5–16 × 10.5–21 µm, pariete sporarum crassiore [1.5–4(–5) µm], et praesentia anamorphae.

Typus in matrice *Cosmos bipinnatus* Cav., Japonia, Hokkaido, Takikawa, Higashi-takikawa, 43°34′49″ N, 141°59′04″ E, alt. ~30 m.s.m., 30.IX.2004, leg. H. Horita. Holotypus in Herbario Ustil. Vánky, HUV 20935!; isotypi in SAPA et in Vánky, Ust. exs. no. 1272. Paratypus in matrice *Cosmos bipinnatus*, Germania, Sachsen-Anhalt, Kreis Wittenberg, Kemberg, hortus Nowitzki, 51°45′54″ N, 12°37′52″ E, alt. 95 m.s.m., 3.VIII.2004, leg. H. Jage 1402/04, HUV 20948!, isoparatypus in Vánky, Ust. exs. no. 1273.

Sori (Fig. 1) forming rounded to usually elongated, first white, later brown leaf spots, 0.5–1.5(–2) × 1–5 mm, or longer by confluence. Teliospores (Fig. 2) embedded in the leaf tissue, moderately crowded, subglobose, ellipsoidal to somewhat irregular, with one or several flattened sides, 9.5–16 × 10.5–21 µm, from subhyaline to pale yellowish-brown; wall 1.5–4(–5) µm thick, two-layered, inner layer even, ~0.5 µm thick, outer layer uneven. Anamorph (*Entylomella*, Fig. 3) present in young sori as a white cover on both surfaces of the leaves, composed of densely situated fascicles of conidiophores protruding from the stomata. Conidiophores simple, slightly irregular, 2–3 × 10–40 µm, hyaline, producing apically 1-celled, more or less bent, hyaline conidiospores measuring 2–2.5 × 10–13 µm.

On Compositae (subfamily Asteroideae): *Cosmos bipinnatus*; Europe (Germany), E. Asia (Japan). It is known from several places in Germany and Japan. It is certainly more widespread but is overlooked.

Entyloma cosmi differs from *E. holwayi* especially in having larger teliospores, a thicker spore wall, and by the presence of an anamorph. It is known only on *Cosmos bipinnatus*.

Slender "conidia," measuring ~1.5–3 × 24–55 µm, observed rarely after heavy rainfalls by the second author, most probably represent basidiospores of in situ germinated teliospores.

2. *Entyloma holwayi* Syd. & P. Syd. in Sydow, Ustilagineen no. 282, 1901.
Type on *Cosmos sulphureus* Cav., Mexico, Chapala, 19.VII.1899, E.W.D. Holway. Lectotype (designated by Vánky et al. 2005) BPI 175509, isolectotypes in Sydow,

Fig. 1. Sori of *Entyloma cosmi* Vánky, Horita & Jage on leaves of *Cosmos bipinnatus* Cav., in which the sori are white due to the covering layer of the anamorph (paratype). *Bar* 1 cm

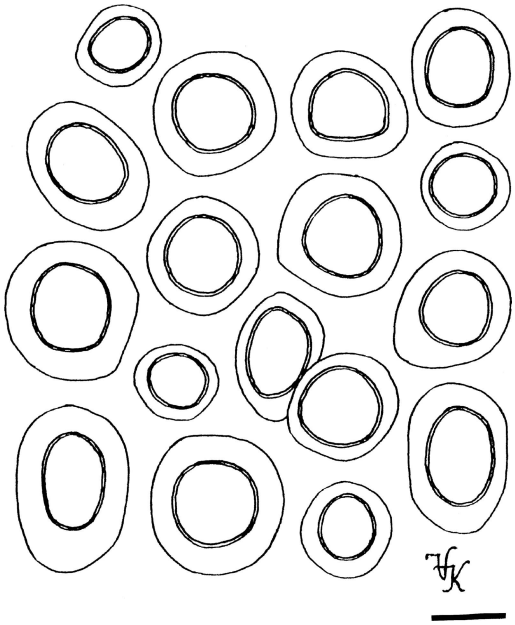

Fig. 2. Teliospores of *Entyloma cosmi* Vánky, Horita & Jage on *Cosmos bipinnatus* Cav. (holotype). *Bar* 10 µm

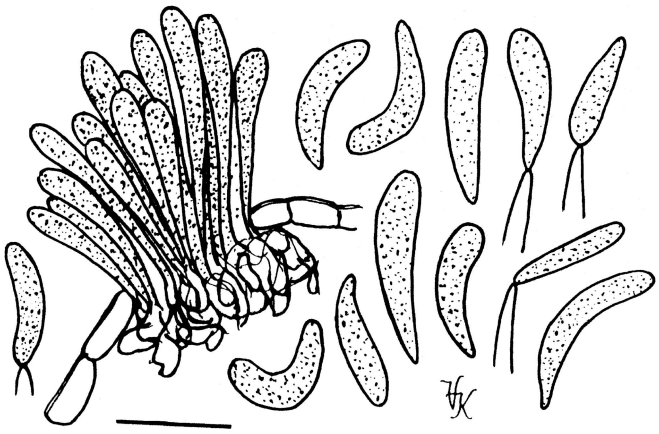

Fig. 3. Conidiospores of *Entyloma cosmi* Vánky, Horita & Jage on *Cosmos bipinnatus* Cav. (topotype). To the *left*, young conidiophores are protruding through the stoma of the host plant. *Bar* 10 µm

Fig. 4. Sori of *Entyloma holwayi* Syd. & P. Syd. on leaves of *Cosmos sulphureus* Cav. (isolectotype). *Bar* 1 cm

Ustilagineen no. 282, HUV 1040! Topotype collected 5.X.1903, E.W.D. Holway; isotopotypes in Seymour & Earle, Econ. Fgi., Suppl. C. no. 108, HUV 9697!.

Sori (Fig. 4) forming leaf spots, rounded, ellipsoidal or elongated, 0.5–3 × 1–4 mm, or larger by confluence, sometimes appearing lobed, usually not delimited by the veins,

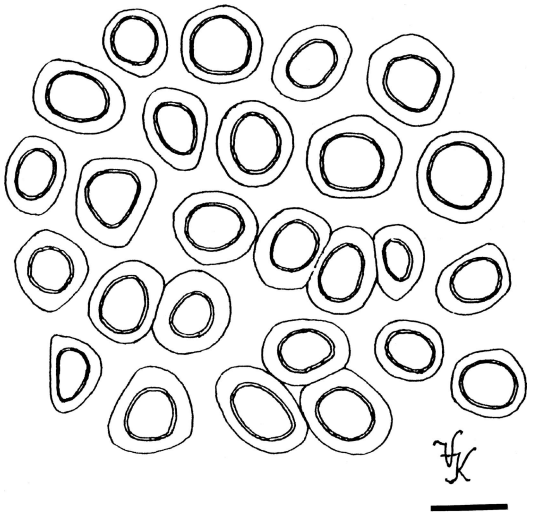

Fig. 5. Teliospores of *Entyloma holwayi* Syd. & P. Syd. on *Cosmos sulphureus* Cav. (isolectotype). *Bar* 10 µm

rusty-brown. Teliospores (Fig. 5) embedded in the leaf tissue, moderately crowded, rather variable in shape and size, subglobose, ellipsoidal to usually more or less irregular, rounded, or with one or several flattened sides, more rarely with 1–2 acute angles, 8–13 × 9–15 µm, from subhyaline to pale yellowish-brown; wall (1–)1.5–3(–3.5) µm thick, two-layered, inner layer even, ~0.5 µm thick, outer layer uneven. Anamorph absent.

On Compositae (subfam. Asteroideae): *Cosmos caudatus* Humb., Bompl. & Kunth, *C. sulphureus* Cav.; North America (Mexico, USA).

Key to the *Entyloma* species of *Cosmos*

1. Sori when young white. Teliospores 10.5–21 µm long, wall 1.5–4(–5) µm thick. Anamorph present . . . ***E. cosmi***
– Sori when young yellowish-brown. Teliospores 9–15 µm long, wall (1–)1.5–3(–3.5) µm thick. Anamorph absent . . . . . ***E. holwayi***

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