

Contributions to the smut fungi of Africa. 5. First record of *Thecaphora thlaspeos*

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Received 29 November 2019 / Accepted 23 December 2019 / Published 25 December 2019

Denchev, T.T. & Denchev, C.M. 2019. Contributions to the smut fungi of Africa. 5. First record of *Thecaphora thlaspeos*. – Mycobiota 9: 1–6. doi: 10.12664/mycobiota.2019.09.01

Abstract. *Thecaphora thlaspeos*, known only from Europe and East Asia (South Korea), is reported for the first time from Africa (from Algeria), on a new host plant, *Arabis pubescens*.

Key words: Africa, Algeria, *Arabis pubescens*, *Brassicaceae*, smut fungi, taxonomy, *Thecaphora thlaspeos*

Introduction

Thecaphora is a large genus in the *Glomosporiaceae* (*Urocystidales*) comprising 63 species on host plants belonging to 16 eudicot families (Vánky 2011, 2013; Kruse et al. 2018; Stajsic et al. 2018). The species of *Thecaphora* develop sori in various plant organs: flowers, ovaries, anthers, fruits, seeds, stems or leaves, exceptionally, in roots or tubers (*T. solani*). Most commonly, their spores are loosely or firmly agglutinated in spore balls, composed of few to many spores (Vánky 2011, 2013). However, four species, *T. australiensis*, *T. capensis*, *T. oxalidis* (on *Oxalidaceae*), and *T. thlaspeos* (on *Brassicaceae*), produce single spores (Roets et al. 2008; Vánky 2011; Stajsic et al. 2018). The spore balls are without sterile cells, with the only exception of *T. smallanthi* which forms spore balls composed of spores outside and small, subhyaline sterile cells in the middle (Piepenbring 2001). In different species, the colour of the mass of spore balls or single spores is too diverse: from cinnamon brown or pale orange to dark golden or dark reddish brown. Over the past few years, various aspects of *T. thlaspeos* like genomics, life cycle, and plant-pathogen interactions have been intensively studied (e.g. Frantzeskakis et al. 2017; Kellner & Göhre 2017; Courville et al. 2019).

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Thecaphora thlaspeos and five species of *Urocystis* are the only known smut fungi to infect hosts in the *Brassicaceae* (Vánky 2011). The host range of *T. thlaspeos* includes 16 species in *Alyssum*, *Arabidopsis*, *Arabis*, *Cardamine*, *Draba*, *Erysimum*, and *Noccaea* (Liro 1924; Denchev 1991; Vánky 2011). This smut fungus is recorded from Europe (Liro 1924; Ciferri 1938; Lindeberg 1959; Jørstad 1963; Vánky 1985, 1994, 2011; Denchev 1991, 2001; Zwetko & Blanz 2004; Scholz & Scholz 2012; Kruse et al. 2014; Frantzeskakis et al. 2017) and South Korea (Denchev et al. 2007). In this article, it is reported for the first time from Africa.

Material and methods

A dried specimen from the herbarium of Royal Botanic Garden, Madrid (MA) was examined under a light microscope (LM) and scanning electron microscope (SEM). For LM observations and measurements, spores were mounted in lactoglycerol solution (w : la : gl = 1 : 1 : 2) on glass slides, gently heated to boiling point to rehydrate the spores, and then cooled. The measurements of spores 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 in an ion sputter. The surface structure of spores was observed and photographed at 10 kV accelerating voltage using a Hitachi S-3000N scanning electron microscope. The description below is based entirely on the specimen examined. The shapes of spores are arranged in descending order of frequency.

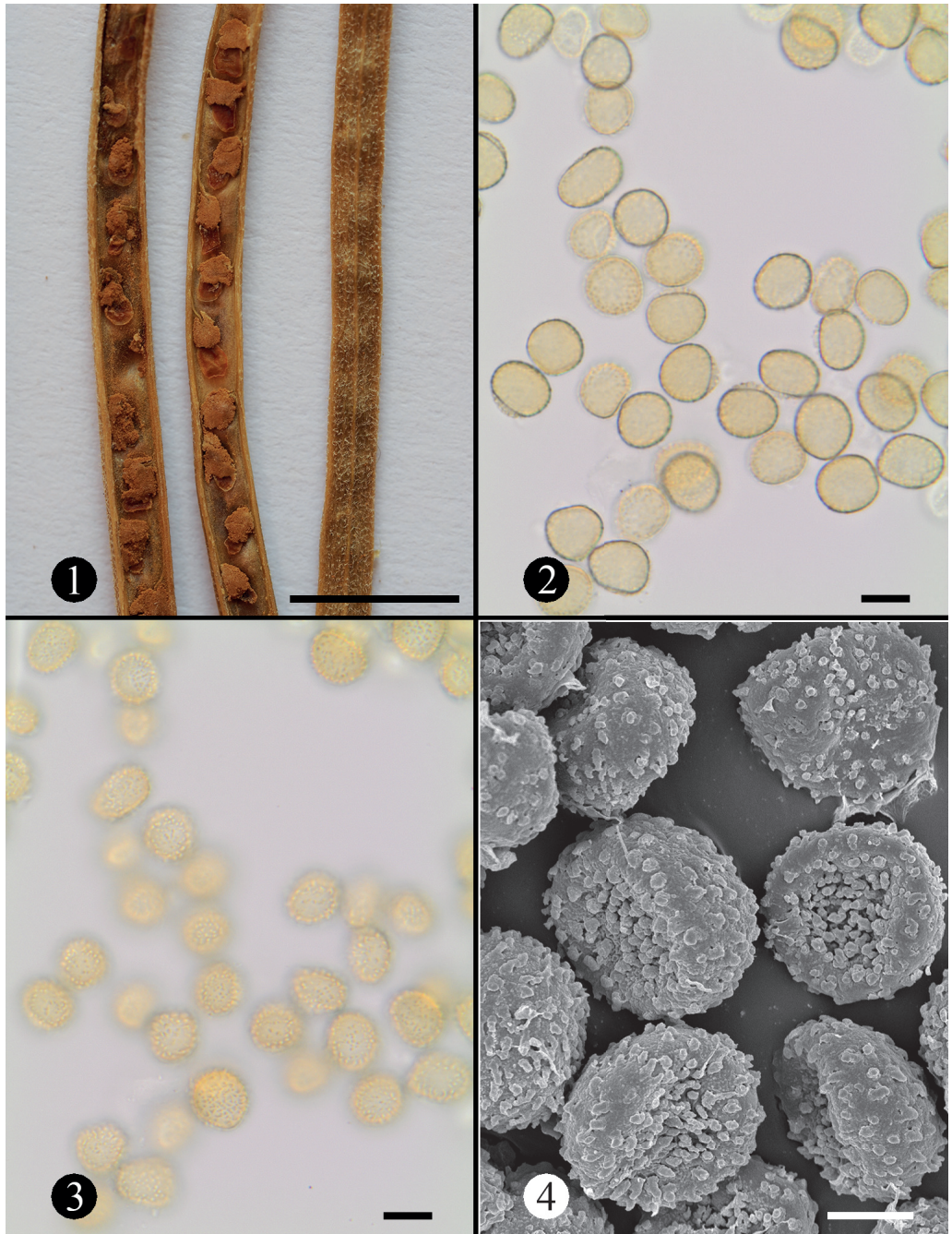
Taxonomy

Thecaphora thlaspeos (Beck) Vánky, Mycotaxon 89: 111, 2004. \equiv *Tilletia thlaspeos* Beck, Verh. K. K. Zool.-Bot. Ges. Wien 35: 362, 1886. \equiv *Ustilago thlaspeos* (Beck) Lagerh., in Sydow, Ustilaginales Exsiccata: no. 118, 1897. \equiv *Baubinus thlaspeos* (Beck) Denchev, Mycotaxon 65: 424, 1997. \equiv *Tothiella thlaspeos* (Beck) Vánky, Mycotaxon 70: 39, 1999. = *Ustilago seminum* Juel, Öfvers. Kongl. Vetensk.-Akad. Förh. 51: 491, 1894. = *Ustilago arabidis-alpinae* Liro, Mycoth. Fenn., Fasc. 16: 108, 1939. = *Ustilago cardamines* Liro, Mycoth. Fenn., Fasc. 16: 108, 1939. Figs 1–6

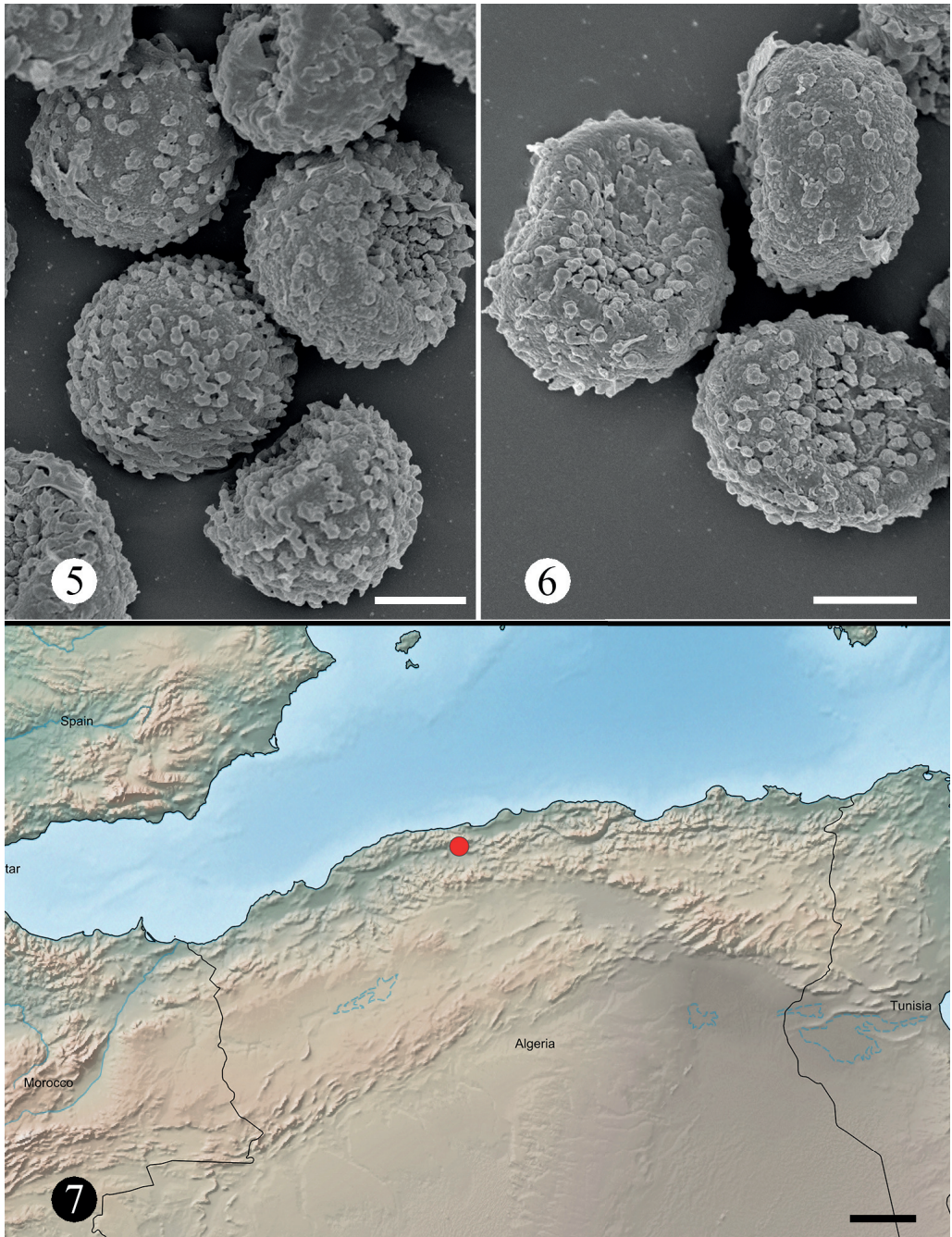
Infection systemic. **Sori** in siliquae, replacing the seeds. Spore mass powdery, light yellowish brown, released when the siliquae open. **Spores** single, variable in shape, subglobose, broadly ellipsoidal, ellipsoidal, globose, irregular, ovoid, reniform or elongated, (10.5–)11.5–17(–18.5) \times (10–)11–13.5(–14.5) (13.7 \pm 1.3 \times 11.9 \pm 0.6) μm ($n_1 = 100$), light to medium yellowish brown; wall 0.5–1.0 μm thick, echinate-verrucose, ornaments up to 0.7 μm high, on a restricted area of the wall ornaments coarser and higher, up to 1.4(–1.7) μm high. In SEM spore wall echinate-verrucose, punctate between the ornaments.

Specimen examined – On *Arabis pubescens* (Desf.) Poir.: ALGERIA, Ain Defla, Mt. Zaccar near Miliana, 36°18'N 02°17'E, June 1920, leg. Ch. d'Alleizette, s.n. (MA 48394; the host plant as '*Arabis hirsuta* DC. α *ciliata*', rev. W. Titz).

Distribution – On *Brassicaceae*: *Alyssum reiseri* Velen., *Arabidopsis petraea* (L.) V.I. Dorof. (*Cardaminopsis petraea* (L.) Hiitonen), *Arabis alpina* L., *A. ciliata* Clairv. (*A.*



Figs 1–4. *Thecaphora thlaspeos* on *Arabis pubescens* (MA 48394). **1.** Habit. **2, 3.** Spores in LM (in median and surface view, respectively). **4.** Spores in SEM. Scale bars: 1 = 0.5 cm, 2, 3 = 10 μm , 4 = 5 μm



Figs 5–6. *Thecaphora thlaspeos* on *Arabis pubescens* (MA 48394) – spores in SEM. **Fig. 7.** Geographic distribution of *Thecaphora thlaspeos* in North Africa (generated with Simple-Mappr, Shorthouse 2010). Scale bars: 5, 6 = 5 μm , 7 = 500 km

corymbiflora Vest), *A. hirsuta* (L.) Scop., *A. pubescens*, *A. sagittata* (Bertol.) DC., *A. serrata* var. *hallaisanensis* (Nakai) Ohwi, *Cardamine bellidifolia* L., *Draba aizoides* L., *D. alpina* L., *D. incana* L., *Erysimum diffusum* Ehrh., *E. welcevii* Urum., *Noccaea alpestris* (Jacq.) Kerguélen (*Thlaspi alpinum* Crantz), *N. brachypetala* (Jord.) F.K. Mey. (*Thlaspi brachypetalum* Jord.), and *N. caerulescens* (J. Presl & C. Presl) F.K. Mey. (*Thlaspi alpestre* L.); Europe, North Africa (Algeria, Fig. 7), and Asia (South Korea).

Thecaphora thlaspeos is a rather inconspicuous species, without obvious infection symptoms. The smut fungus can be seen once siliquae are opened and the spore mass becomes exposed.

Arabis pubescens is endemic to Mediterranean North Africa, known from Morocco, Algeria, and Tunisia (Maire 1967; Pottier-Alapetite 1979; Marhold 2011). It is a new host plant record for *Thecaphora thlaspeos*.

Acknowledgements. This research received support (Grant no. ES-TAF-6618) from the SYNTHESYS Project <http://www.synthesys.info/> which is financed by European Community Research Infrastructure Action under the FP7 “Capacities” Program at the Real Jardín Botánico (CSIC). The assistance of Prof. Maria T. Tellería, Dr Maria P. Martín, Dr Margarita Dueñas, Dr Yolanda Ruiz-León (RJB), and the staff of MA is kindly acknowledged.

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