



British Mycological
Society promoting fungal science

journal homepage: www.elsevier.com/locate/funbio



CrossMark

New species of *Ophiocordyceps unilateralis*, an ubiquitous pathogen of ants from Thailand

Noppol KOBMOO^{a,*}, Suchada MONGKOLSAMRIT^a,
Taksadon WUTIKHUN^b, Kanoksri TASANATHAI^a, Artit KHONSANIT^a,
Donnaya THANAKITPIPATTANA^a, Janet Jennifer LUANGSA-ARD^a

^aMicrobe Interaction Laboratory, National Center for Genetic Engineering and Biotechnology (BIOTEC),
113 Thailand Science Park, Phahonyothin Road, Khlong Nueng, Khlong Luang, Pathum Thani 12120, Thailand

^bTechnician Officer Institution, The National Nanotechnology Center, 130 Thailand Science Park, Phahonyothin Road,
Klong Nueng, Klong Luang, Pathum Thani 12120, Thailand

ARTICLE INFO

Article history:

Received 6 February 2014

Received in revised form

2 October 2014

Accepted 29 October 2014

Available online 6 November 2014

Corresponding Editor:

Joseph W. Spatafora

Keywords:

Cryptic species

Host specificity

Molecular phylogenies

Species diversity

ABSTRACT

Ophiocordyceps unilateralis is an ubiquitous pathogen of ants with hidden phylogenetic diversity associated with host specificity. In this study, we describe two new species to this species complex: *Ophiocordyceps septa* and *Ophiocordyceps rami*. Both were found on unidentified ants of the genus *Camponotus* (*C. sp.1* and *C. sp.2* respectively). *Ophiocordyceps septa* is very similar to *Ophiocordyceps polyrhachis-furcata*, *Ophiocordyceps camponoti-leonardi*, and *Ophiocordyceps camponoti-saundersi* (found respectively on the ants *Polyrhachis furcata*, *Camponotus leonardi*, and *Camponotus saundersi*) but differs in the size, the shape and the septation of the ascospores, while *O. rami* is clearly identifiable with macro-morphological features including multiple stromata similar to *Ophiocordyceps halabalaensis* on *Camponotus gigas*. A thorough morphological examination was also provided for *O. polyrhachis-furcata*, *O. camponoti-leonardi*, and *O. camponoti saundersi*, showing that the first was apparently distinguishable from the others by the absence of septation of the ascospores. A combined molecular phylogeny also supports *O. septa* and *O. rami* as distinct new species.

© 2014 The British Mycological Society. Published by Elsevier Ltd. All rights reserved.

Introduction

Fungal ant pathogens were believed to be rare, and records of them were scarce (Allen & Buren 1974; Schmid-Hempel 1998). However, efforts have been made continuously to investigate their diversity and contribute to a better comprehension of their habitats (Evans & Samson 1982; Evans & Samson 1984, Evans et al. 2010, Evans et al. 2011). The most ubiquitous fungal pathogen of ants is the fungus *Ophiocordyceps unilateralis* (Tul.) Pech. Much attention has been given to this species because of

its outstanding way of life: infecting and modifying the ants' behaviour in order to favour its own transmission (Andersen et al. 2009, Pontoppidan et al. 2009; Hughes et al. 2011). The ants, infected by *O. unilateralis*, have been reported to die with their jaws clamped on elevated vegetal substrates, hanging themselves upside down.

This species was first described by Tulasne & Tulasne (1865) under the name *Torrubia unilateralis*. Successive collections of this species complex from around the world have demonstrated that it only attacks ants from the tribe

* Corresponding author.

E-mail address: noppol.kob@biotec.or.th (N. Kobmoo).

<http://dx.doi.org/10.1016/j.funbio.2014.10.008>

1878-6146/© 2014 The British Mycological Society. Published by Elsevier Ltd. All rights reserved.

Camponotini (subfamily Formicinae) (Evans & Samson 1984; Evans et al. 2011). This tribe is also attacked by *Ophiocordyceps myrmecophila* (Luangsa-ard et al. 2007), *Ophiocordyceps irangiensis* (Hywel-Jones 1996; Luangsa-ard et al. 2010), *Ophiocordyceps lloydii* (Evans & Samson 1984) and *Ophiocordyceps pulvinata* (Kepler et al. 2010). The taxonomy of *O. unilateralis* is problematic because its first description by Tulasne & Tulasne (1865) did not provide any description of sexual structures including ascomata, asci, and ascospores. Therefore, this species was characterised only by a lateral ascomatal cushion that developed on the stroma growing from the back of the ants' heads. Any specimen approximating this description is likely to be identified as *O. unilateralis*, thus the term “*sensu lato*” is frequently used in some literature (Evans et al. 2011; Kobmoo et al. 2012). The morphology of *O. unilateralis* s.l. is variable which was considered to represent intraspecific phenotypic variation and not a basis for the existence of co-occurring species (Evans & Samson 1984). However, recent studies have called for the delineation of distinct host-specific species and for a status change to a species complex rather than phenotypic plasticity (Evans et al. 2011; Kobmoo et al. 2012). Evans et al. (2011) described four new species of *O. unilateralis* s.l. found on four different ant species in Brazil: *Ophiocordyceps camponoti-rufipedis* on *Camponotus rufipes*, *Ophiocordyceps camponoti-balzani* on *Camponotus balzani*, *Ophiocordyceps camponoti-melanotici* on *Camponotus melanoticus*, and *Ophiocordyceps camponoti-novogranadensis* on *Camponotus novogranadensis*. Despite the lack of molecular data, sufficient micro-scale morphological characteristics were evident to indicate the differences between these host-specific taxa. These micro-morphological differences were based on shape, size, and septation of ascospores; and also the types of phialides and conidia.

Kobmoo et al. (2012) used a molecular phylogenetic approach to demonstrate host-specific divergence between *O. unilateralis* specimens found on *Polyrhachis furcata*, *Camponotus leonardi*, and *Camponotus saundersi* ants. Interestingly, macro-morphological examinations did not reveal any significant differences, suggesting cryptic speciation within this species complex. The specimens found on these three ants were thus given new species names *Ophiocordyceps polyrhachis-furcata*, *Ophiocordyceps camponoti-leonardi*, and *Ophiocordyceps camponoti-saundersi*, respectively. In the same study, some molecular data were presented on specimens found on unidentified ants of the genera *Camponotus* and *Polyrhachis* but morphological examinations have yet to be performed on those specimens.

Luangsa-ard et al. (2011) described *Ophiocordyceps halabalaensis* found on *C. gigas* ants in the south of Thailand. This species fit the broad description of *O. unilateralis* s.l., having a stipitate stroma emerging between the head and the thorax of the ants. However, it also displayed two other stromata emerging from the top joints between the left and right forelegs and the thorax. These morphological differences justified the nomination of a new species, a decision that was supported by the molecular data showing it to be closely related to, but different from *O. unilateralis* on the ant *C. leonardi*. Finally, *O. pulvinata* was found on the ant *Camponotus obscuripes* in Japan. Based on its morphological characteristics, this species did not fit the broad description of *O. unilateralis* because it

lacked a stipitate stroma supporting an ascomatal cushion. However, it also shows an extended phenotype similar to *O. unilateralis*: the ant demonstrates a behaviour modification by biting a twig; and the molecular data showed its very close relationship to *O. unilateralis* (Kepler et al. 2010).

In the current study, we describe two new species of the *O. unilateralis* species complex which have been found in Thailand on ant species different from those reported previously. Their species status is supported by a molecular phylogeny, as is their close phylogenetic relationship to species of *O. polyrhachis-furcata*, *O. camponoti-leonardi*, *O. camponoti-saundersi*. The morphology of these three taxa was also re-examined in comparison to the two species described in this studies.

Material and methods

Collection and management of specimens

During ongoing biodiversity survey in Thailand, we discovered new specimens of *Ophiocordyceps unilateralis* on ant species different to those found in previous studies (Evans et al. 2011; Kobmoo et al. 2012). Two groups of specimens could be distinguished based on hosts, distinct unidentified *Camponotus* ants (*C. sp.1* and *C. sp.2*) (Figs 1 and 2). Actually, *O. unilateralis* on *C. sp.1* was already found in Kobmoo et al. (2012) but there were too few samples for complete morphological descriptions and were thus used for molecular work instead. In contrast, *O. unilateralis* on *C. sp.2* is being reported here for the first time. Both types of specimens have morphological characteristics of *O. unilateralis* in a broad sense (*sensu lato*) in that they possess lateral ascomatal cushions on a stroma growing from the joint between the head and the thorax of the ants. However, those found on *C. sp.2* also have another two stroma growing from the joints between the thorax and both forelegs of the ants (Fig 1). We were not able to isolate the specimens into pure culture. Therefore, some specimens were used for DNA extraction from fresh stroma. Others were subjected to morphological examination. After the extraction, the ants were dried in a food dehydrator for one day and deposited at BIOTEC Bangkok Herbarium (BBH).

New specimens of *O. unilateralis* on the ants *Polyrhachis furcata*, *Camponotus leonardi*, and *Camponotus saundersi* were also collected for thorough morphological examinations and additional molecular data (Table 1).

Morphological examinations

The important component of the sexual state, i.e. perithecial plate, was prepared for microscopic observation by rehydration in sterile water until become soft. Free-hand longitudinal sections of tissues were mounted in cotton blue and lactophenol; perithecia, asci, and ascospores were measured using a light microscope. For asexual state, samples were examined by using Scanning Electron Microscopy. The type of *Hirsutella* phialides (A-type, B-type and C-type) were identified according to Evans & Samson (1982, 1984) and Evans et al. (2011).

We re-examined specimens of *Ophiocordyceps polyrhachis-furcata*, *Ophiocordyceps camponoti-leonardi*, and *Ophiocordyceps camponoti-saundersi* to compare with the two new species

Download English Version:

<https://daneshyari.com/en/article/4356892>

Download Persian Version:

<https://daneshyari.com/article/4356892>

[Daneshyari.com](https://daneshyari.com)