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RESEARCH ARTICLE

The first record of *Pisolithus arhizus* (*Sclerodermataceae*, *Basidiomycota*) in Central Asia

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Abstract. *Pisolithus* is a genus of gasteroid mycorrhizal symbionts associated with trees of several families of angiosperms and gymnosperms and distributed almost worldwide. Here we report a new record of *Pisolithus arhizus* from Tashkent, Uzbekistan, the first record of this species in Central Asia. The fruit bodies of *P. arhizus* were collected in several locations within the city and identified based on morphological characters. The ectomycorrhizal fungus formed symbiotic relationships with *Juniperus* sp. and *Quercus* sp. We provide its morphological description and photographs and also discuss our findings in the context of previously known records of this species.

Keywords: ectomycorrhiza, epigeous basidiomata, gasteroid fungi, urban area

Introduction

The genus *Pisolithus* Alb. & Schwein. (*Sclerodermataceae*, *Boletales*, *Agaricomycetes*), first described in 1805 (Albertini, Schweinitz, 1805), currently comprises a total of ca. 30 species globally (<https://www.indexfungorum.org/names/>). The genus is characterized by fruit bodies of variable shape and size, often with a well-developed rooting base (Jaouni et al., 2015). Most species are widely distributed across temperate to tropical regions and form ectomycorrhizal (ECM) associations with a variety

of woody plants (Marx, 1977; Chambers, Cairney, 1999; Rusevska et al., 2015). The species of *Pisolithus* occur in a range of habitats including forests, orchards, urban sites, and eroded soils (Marx, 1977; Malloch, Kuja, 1979; Castellano, Trapp, 1991; Salah et al., 2009; Phosri et al., 2012; Martín et al., 2013; Jaouni et al., 2015; Rusevska et al., 2015).

Pisolithus arhizus (Scop.) Rauschert is the most common representative of the genus. It is characterized by roughly spherical fruit bodies with peridium of yellow, purple or brown shades (Rauschert, 1959). *Pisolithus arhizus* is known to form ECM

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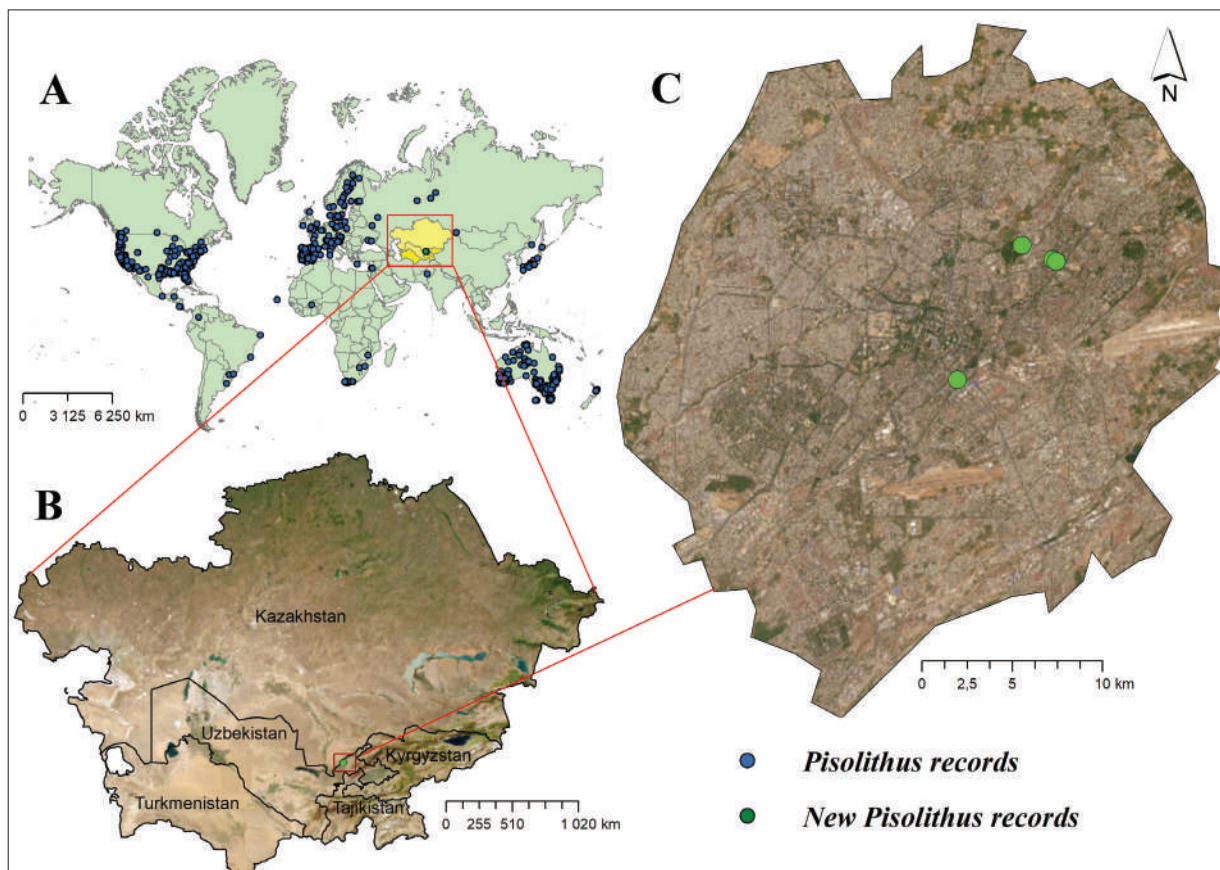


Fig. 1. A: Worldwide distribution of the species of *Pisolithus* according to GBIF data (GBIF, 2023); B: Map of five Central Asian countries; C: Map of Tashkent city showing sites of *P. arhizus*

associations with a variety of trees, including species of *Acacia*, *Cistus*, *Eucalyptus*, *Quercus*, *Larix*, and *Pinus* (Kope, Fortin, 1990; Turjaman et al., 2005; Pereira, Baseia, 2009; Popova, 2021). Up to now, this species has not been reported in Central Asia (Zaprometov, 1928; Panfilova, Gaponenko, 1963; Gaponenko, 1965; Shavrtsman, Filimonova, 1970; Petrova, 1985; Khalikova, 1989; Iminova, 2009). In 2022, during our mycological observation in Tashkent (Uzbekistan), we found several basidiomata identified as *P. arhizus* based on morphological data. This is also the first record of the species from Uzbekistan.

Material and methods

Study area

Uzbekistan is a Central Asian country with a high biodiversity level (Fig. 1). Tashkent (also Toshkent),

a city in the north-east of the country, is located near the foothills of the Tianshan (Tian Shan) Mountains, in the valley of the Chirchik (Chirchiq) River, at about 440–480 m altitude. The climate is continental. The city harbours a variety of plant communities that provide habitats for several rare and hitherto unreported macrofungi. Our study area is dominated by broad-leaved trees rather than numerous conifers. Agaricoid fungi are widespread and occur on various substrates such as manure, dead or living wood, needle litter, humicolous soil, or form ectomycorrhizal links.

Morphological study

The material was collected in June 2020–2022, at the end of the vegetative growth period, in the parts of Tashkent city where oak trees grow (Fig. 1). In total, 18 fruit bodies of the fungus were found. *In situ* pictures were taken with a Canon EOS 750D digital camera. The collected basidiomata were studied

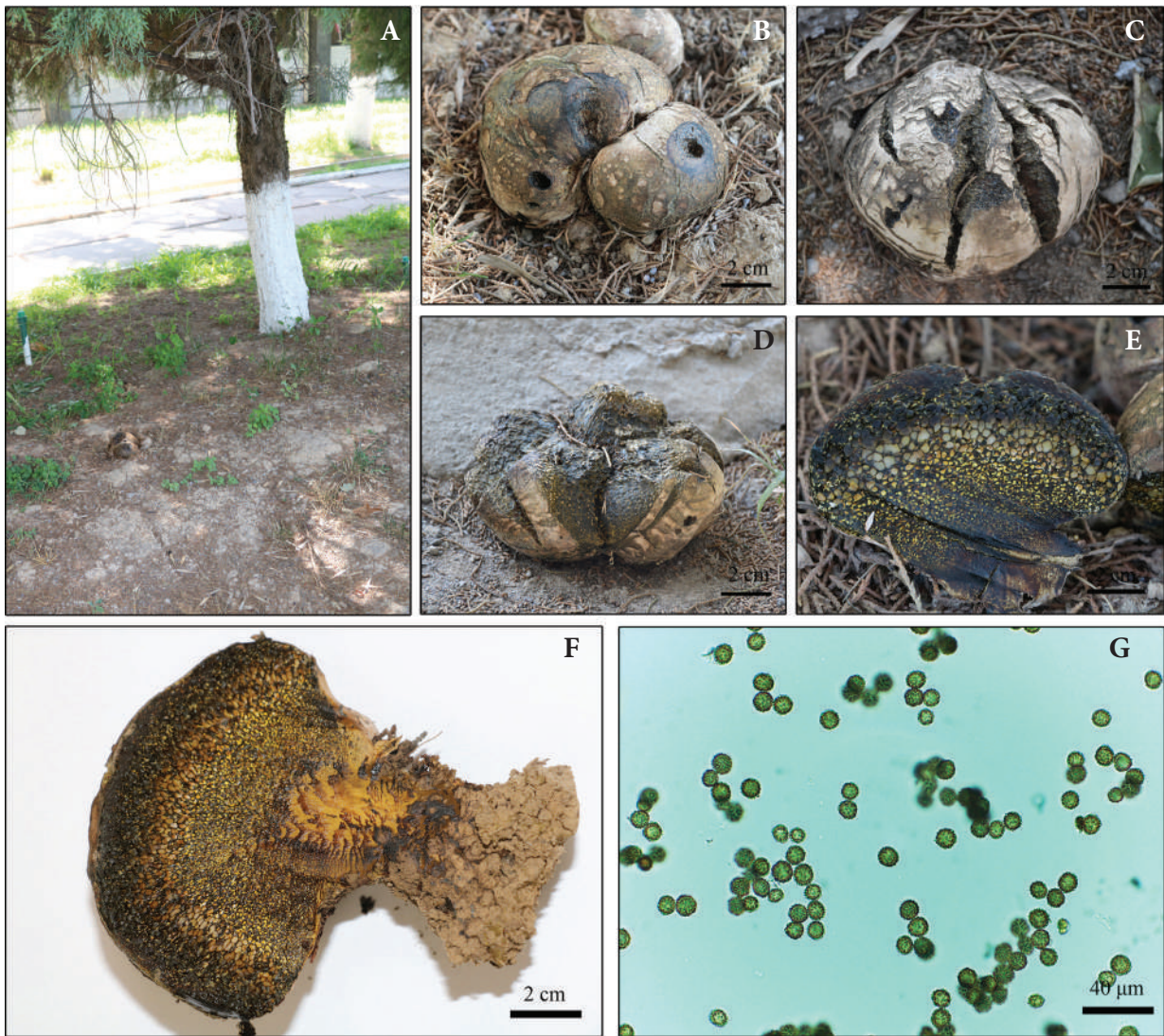


Fig. 2. A: Habitat of *Pisolithus arhizus* growing under *Juniperus* sp.; B–D: Basidiomata; E, F: Transverse section of basidiomata; G: Basidiospores

in the laboratory following Pegler et al. (1995). We examined free hand sections and squash mounts in 5% potassium hydroxide under a light microscope (Moticam N-300M) and measured 50 spores per specimen. The specimens are deposited at the Mycological Herbarium of the Institute of Botany of the Uzbekistan Academy of Sciences in Tashkent (TASM).

Results and Discussion

Pisolithus arhizus (Scop.) Rauschert, Z. Pilzk. 25 (2): 50. 1959 (Fig. 2)

Lycoperdon arhizon Scop., Delic. Fl. Faun. Insubr. 1: 40. 1786. – *Scleroderma tinctorium* Pers., Syn. meth. fung. (Göttingen) 1: 152. 1801. – *Pisolithus tinctorius* (Pers.) Coker & Couch, Gasteromycetes E. U.S. Canada: 170. 1928.

Basidiomata 8–20 cm high, 4–10 cm wide, rounded to lobed, becoming subglobose to ellipsoid, club-shaped, with a sterile fibrous stipe. Peridium pale ochre to brown or black, thin, membranous, smooth, single-layered. Stipe solid, up to 25 mm wide, yellowish-brown. Gleba develop within peridioles, 1–5 mm long, ellipsoid-ovoid, lens-shaped, embedded in a black gelatinous matrix. In

Table 1. Comparison of macro- and micromorphological characters of *P. arhizus* obtained in this study with bibliographic data

Macro- and microstructure characters	This study	Coker, Couch, 1928	Rauschert, 1959
Basidiomata	8–16 cm high, 4–10 cm wide, subglobose to ellipsoid	18 cm high, 10.5 cm wide, irregularly globose or pear-shaped	5–9 (11) cm high, 5–9 cm wide, subglobose
Peridioles	1–5 mm wide, ellipsoid-ovoid	1–4 mm wide, subspherical or irregularly angular	2–5 mm wide, subspherical
Basidia	not observed	not observed	not observed
Basidiospores	9–12 μm , globose	7–11.5 μm , globose	7–10 μm , globose

mature basidiomata, peridiole walls collapse, tar-like material dries out and gleba transforms into a powdery mass. Basidiospores bright yellow-brown, 9–12 μm in diameter (including ornamentation), globose, densely spinose, with erect or slightly curved spines, isolated at the base, up to 2 μm long. Basidia not observed.

Comparison of morphometric measurements of selected macro- and microstructures of the collected basidiomata of *P. arhizus* with those from different sources are presented in Table 1.

Although the urban area of Tashkent exhibits high biodiversity, mycological studies were conducted only in some parts of the city and for some groups of fungi. In particular, for the F.N. Rusanov Botanical Garden of the Uzbekistan Academy of Sciences, located within the city of Tashkent, 276 species of microfungi have been reported (Kamilov, 1991). As for macrofungi, no extensive examination of the urban area of Tashkent has been done (Khalikova, 1989). The urban dendroflora is dominated mainly by members of the *Fagaceae* and *Cupressaceae* families, and thus the area represents appropriate habitats for rare, undetected or neglected gasteroid fungi.

The present study explores the diversity of the little known genus *Pisolithus* in the urban area of Tashkent. As a result, we provide the first record of *P. arhizus* in Uzbekistan (Fig. 1). According to GBIF data (GBIF, 2023), this fungus is known in various countries in Europe, Asia, North America, etc. It is often considered a rare species and is included in the Red Lists or Red Data Books of several countries (Gyosheva et al., 2006; Kålås et al., 2010; Karadelev, Rusevska, 2013).

Identification of species in the genus *Pisolithus* relies primarily on basidioma and basidiospore shape and size, position of basidiomata in

the ground, peridiola size, and peridium color (Rauschert, 1959). Our finds of *P. arhizus* in Uzbekistan are characterized by formation of subglobose to ellipsoid yellowish-brown fruit bodies. Morphologically, our specimens of *P. arhizus* are similar to those from Germany and Canada (Rauschert, 1959; Coker, Couch, 1928; Table 1). The species has previously been recorded in Pakistan and Iran, which are the nearest known locations to Uzbekistan (GBIF, 2023). We suggest that the fungus was probably introduced into Uzbekistan with roots of various seedlings of ornamental plants or via spores spread by various other means.

This finding indicates the presence of many unidentified or undescribed species in the mycobiota of the region that have not yet been studied. Further in-depth morphological and molecular research and taxonomic revision of the *Pisolithus* species from Central Asia are needed.

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Ethics Declaration

The authors declare no conflict of interest.

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Перша знахідка гриба *Pisolithus arhizus* (Sclerodermataceae, Basidiomycota) в Центральній Азії

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Реферат. Рід *Pisolithus* містить види гастероїдних мікоризних симбіонтів, асоційованих із деревними рослинами з кількох родин і поширених майже по всьому світу. У статті повідомляється про знахідку *Pisolithus arhizus* у Ташкенті, яка виявилась першою знахідкою в Узбекистані і загалом у Центральній Азії. Плодові тіла *P. arhizus*, зібрані в кількох локалітетах у межах міста, були ідентифіковані за морфологічними ознаками. Знайдений ектомікоризний гриб асоційований з *Juniperus* sp. і *Quercus* sp. Наведено морфологічний опис гриба, ілюстрації та порівняння з раніше відомими знахідками цього виду.

Ключові слова: гастероїдні гриби, ектомікориза, епігейні базидіоми, міська зона