



Truffle Checklist of Turkey II with A New Record

Ilgaz Akata^{1,a,*}, İsmail Şen^{2,b}, Mustafa Sevindik^{3,c}, Şanlı Kabaktepe^{4,d}

¹Department of Biology, Faculty of Science, Ankara University, Ankara, Türkiye

²Department of Biology, Faculty of Science, Muğla Sıtkı Koçman University, Muğla, Türkiye

³Department of Food Processing, Bahçe Vocational School, Osmaniye Korkut Ata University, Osmaniye, Türkiye

⁴Department of Herbal and Animal Production, Battalgazi Vocational School, Malatya Turgut Ozal University, Battalgazi, Malatya, Türkiye

*Corresponding author

ARTICLE INFO

Research Article

Received : 03/09/2022

Accepted : 04/10/2022

Keywords:

Fungal diversity

Truffles

New records

Tuber oligospermum

Türkiye

ABSTRACT

The current study presents a Turkish Truffle Checklist based on literature and a newly discovered species. Within the two divisions, the list includes 104 species belonging to 35 genera and 20 families, as well as their range and Turkish names. *Tuber oligospermum* was one of them, and it was recorded for the first time in Turkey. A brief description of newly reported species was provided, along with images of their macro and micro-morphology.

^a akatailgaz@gmail.com

^b <https://orcid.org/0000-0002-1731-1302>

^c frapesle@gmail.com

^d <https://orcid.org/0000-0001-5760-5535>

^c sevindik27@gmail.com

^d <https://orcid.org/0000-0001-7223-2220>

^d sanli.kabaktepe@ozal.edu.tr

^d <https://orcid.org/0000-0001-8286-9225>



This work is licensed under Creative Commons Attribution 4.0 International License

Introduction

The word "truffles" refers to an ectomycorrhizal hypogean fungal group that belongs to the *Ascomycota* and *Basidiomycota* divisions. Due to their complex taste and peculiar aroma, some members of the truffle genus, such as *Picoa* Vittad., *Terfezia* (Tul. & C. Tul.) Tul. & C. Tul., *Tirmania* Chatin, and *Tuber* P. Micheli ex F.H. Wigg., are economically and gastronomically important.

Tuber species are among them, and some of its members, such as *T. aestivum* (Wulfen) Spreng, *T. borchii* Vittad., *T. melanosporum* Vittad., and *T. magnatum* Picco, are prized.

Truffles are ectomycorrhizal fungi that are mostly connected with plant families including *Pinaceae*, *Fagaceae*, *Myrtaceae*, and *Salicaceae* (Trappe et al., 2009; Bonito Smith, 2016). As a result of their interaction with plants and animals, truffles can be found all over the world

(Trappe et al., 2009). Furthermore, 4500 to 5500 species producing hypogeous/sequestrate fruiting structures are predicted to occur globally (Mueller et al., 2007).

Turkey is a peninsula with three phytogeographical regions: Euro-Siberian, Mediterranean, and Irano-Turanian (Davis et al., 1971). As a result of this unique geographical structure, plant and animal variety is encouraged.

The adaption of plant and animal diversity and favorable climatic circumstances encourage truffle diversity in Turkey, and truffles can thus be found throughout the country. (Kagan-Zur and Akyüz, 2014; Sesli et al., 2020; Şen et al., 2016). Even though more than 5800 fungi species have so far been reported from Turkey by several researchers (Sesli et al., 2020), the knowledge of truffles distributed in Turkey is still limited.

Materials and Methods

The truffle checklist was created by the accumulation of the data obtained from 99 publications on Turkish mycobiota issued between 1937 and March 2022. All species given in the list were checked to obtain the current names, authors, and families by accessing the fungal database, Index Fungorum (access date: 14.07.2022). Likewise, Sesli et al. (2020) accumulated Turkish names of the species.

The samples related to newly reported species were collected from Şanlıurfa province of Turkey as a consequence of routine field studies. The morphological and ecological properties of each specimen were noted. In the laboratory, the microscopic features of specimens such as spore shape and size, structures of peridium, etc., were evaluated by using a light microscope. The specimens were stored as fungarium material in Ankara University Herbarium, Ankara (ANK).

Results

A total of 104 truffle species are listed and their distributions were given below in alphabetical order.

Taxonomic overview

Ascomycota Caval.-Sm.

Helvellaceae Fr.

- *Balsamia gunerii* (H.H. Doğan, Bozok & Taşkın)

K. Hansen & X.H. Wang

Osmaniye (Doğan et al., 2018).

- *B. hellenica* (Kaounas, Agnello, P. Alvarado & Slavova) K. Hansen & X.H. Wang Gaziantep (Uzun et al., 2018).

- *B. vulgaris* Vittad.

Muğla (Allı and Doğan, 2019).

Elaphomycetaceae Tul. ex Paol.

- *Elaphomyces anthracinus* Vittad.

Trabzon (Uzun, 2021).

- *E. citrinus* Vittad.

Trabzon (Uzun and Kaya, 2020a).

- *E. cyanosporus* Tul. & C. Tul.

Trabzon, Rize (Uzun and Kaya, 2020a; 2022).

- *E. decipiens* Vittad.

Trabzon (Uzun and Kaya, 2021).

- *E. granulatus* Fr.

Giresun, Trabzon, Rize (Uzun and Kaya, 2019a).

- *E. leucocarpus* Vittad.

Artvin, Tekirdağ, Trabzon (Türkoğlu et al., 2015).

- *E. muricatus* Fr.

Artvin, Karabük (Türkoğlu et al., 2015; Uzun and Kaya, 2022).

- *E. septatus* Vittad.

İstanbul (Uzun and Kaya, 2019b).

Pyronemataceae Corda

- *Genea hispidula* Berk. ex Tul. & C. Tul.

Trabzon (Uzun and Kaya, 2019c).

- *G. klotzschii* Berk. & Broome

Samsun (Türkoğlu and Castellano, 2014).

- *G. lobulata* (Mor.-Arr., J. Gómez & Calonge) P. Alvarado & Mor.-Arr.

Niğde (Berber et al., 2019).

- *G. sphaerica* Tul. & C. Tul.

İzmir (Türkoğlu et al., 2015).

- *G. verrucosa* Vittad.

Muğla (Türkoğlu and Castellano, 2014).

- *Geopora cooperi* Harkn.

Bolu, Burdur, Denizli, İzmir, Muğla (Solak et al., 2003; Türkoğlu et al., 2015).

- *Hydnocystis bombycina* (Vittad.) Healy & M.E. Sm. Samsun (Türkoğlu and Castellano, 2014).

- *H. piligera* Tul.

Aydın (Kaygusuz et al., 2018).

- *Picoa juniperi* Vittad.

Afyon, Antalya, Denizli, Elazığ, Kayseri Konya, Malatya, Muğla, Nevşehir, Uşak (Türkoğlu and Castellano, 2014; Türkoğlu et al., 2015; Türkoğlu and Yağız, 2012; Akyüz et al., 2015a; 2015b, 2016; 2017; Sahin et al., 2021).

- *P. lefebvrei* (Pat.) Maire

Aksaray, Denizli, Elazığ, Konya, Malatya, Şanlıurfa (Gücin et al., 2010; Türkoğlu et al., 2015; Akyüz et al., 2015a; 2015b, 2016; 2017; Kaya, 2015).

Peizizaceae Dumort.

- *Hydnobolites cerebriformis* Tul. & C. Tul.

Rize and Trabzon (Uzun and Kaya, 2018; 2022).

- *Pachyphlodes citrina* (Berk. & Broome) Doweld Rize and Trabzon (Uzun and Kaya, 2018).

- *P. conglomerata* (Berk. & Broome) Doweld

Giresun and Trabzon (Uzun and Kaya, 2018).

- *Terfezia albida* Ant. Rodr., Muñ.-Moh. & Bordallo Karaman (Uzun et al., 2016).

- *T. arenaria* (Moris) Trappe

Aydın, Isparta, Konya, Malatya (Öder, 1988; Işıloğlu and Öder, 1995; Afyon, 1996; Kaşık et al., 1998; Türkoğlu et al., 2015).

- *T. boudieri* Chatin

Batman, Denizli, Diyarbakır, Elazığ, Gaziantep Karaman, Malatya, Mardin, Niğde, Şanlıurfa (Türkoğlu and Yağız, 2012; Akyüz et al., 2015a; 2015b, 2016; 2017; Gücin, 1990; Yıldız and Ertekin, 1997; Kaşık et al., 2001; Doğan and Öztürk, 2006; Demir et al., 2007; Kaya et al., 2012; Gezer et al., 2014; Kaya, 2015, Dündar et al, 2012, Sevindik et al., 2018).

- *T. cistophila* Ant. Rodr., Bordallo, Kaounas & Morte Trabzon (Uzun and Kaya, 2019; 2022).

- *T. claveryi* Chatin

Adana, Aksaray, Elazığ, Denizli, Diyarbakır, Karaman, Konya, Malatya Şanlıurfa, Yozgat (Akyüz et al., 2015a; 2015b, 2016; 2017; Türkoğlu et al., 2015; Doğan and Kurt, 2016; İnci and Kırbacı, 2018).

- *T. leptoderma* (Tul. & C. Tul.) Tul. & C. Tul.

Denizli, Uşak (Castellano and Türkoğlu, 2012; Türkoğlu and Castellano, 2014).

- *T. olbiensis* (Tul. & C. Tul.) Sacc.

Elazığ, Gaziantep, Konya, Malatya, Nevşehir, Uşak (Akyüz et al., 2015a; 2015b, 2016; 2017; Türkoğlu and Castellano, 2014; Uzun et al., 2015).

- *Tirmania pinoyi* (Maire) Malençon

İzmir (Yılmaz Ersel and Solak, 2004).

Tuberaceae F. Berchtold & J. Presl

- *Choiromyces meandriformis* Vittad.

Bolu, Samsun, Uşak (Türkoğlu and Castellano, 2014).

- *Reddellomyces parvulosporus* (G.W. Beaton & Malajczuk) Trappe, Castellano & Malajczuk

Antalya, Muğla (Türkoğlu, 2015; Ünal et al, 2016).

- *R. westraliensis* (G.W. Beaton & Malajczuk)

Trappe et al.

Muğla (Ünal et al, 2016).

- *Tuber aestivum* (Wulfen) Spreng.

Antalya, Artvin, Aydın, Bolu, Burdur, Denizli, Düzce, Hatay, İstanbul, İzmir, Kırklareli, Konya, Muğla, Ordu, Osmaniye (Gezer et al., 2014; Türkoğlu et al., 2015; Alkan et al, 2018; Özderin et al., 2018).

- *T. borchii* Vittad.

Aydın, Denizli, Kahramanmaraş, Muğla, Samsun, Tekirdağ (Kaya, 2009a; Gezer et al., 2014; Elliot et al., 2016).

- *T. brumale* Vittad.

Denizli, Niğde, Osmaniye, Samsun (Öztürk et al., 1997; Gezer et al., 2014; Türkoğlu and Castellano 2014).

- *T. excavatum* Vittad.

Denizli, Trabzon (Türkoğlu and Castellano, 2014; Uzun and Yakar, 2018).

- *T. ferrugineum* Vittad.

Antalya, Aydın, Denizli (Elliot et al., 2016).

- *T. fulgens* Qué.

Kırklareli (Akata et al., 2020).

- *T. macrosporum* Vittad.

Tekirdağ and Edirne (Doğan, 2021).

- *T. mesentericum* Vittad.

Denizli (Castellano and Türkoğlu, 2012; Türkoğlu and Castellano, 2014).

- *T. nitidum* Vittad.

Denizli, Burdur, Kastamonu, Osmaniye (Castellano and Türkoğlu, 2012; Türkoğlu and Castellano, 2014; Türkoğlu et al., 2015).

• *Tuber oligospermum* (Tul. & C. Tul.) Trappe (Figure1, 2).

Syn. Delastreopsis oligosperma (Tul. & C. Tul.) Mattir., *Lespiaultinia oligosperma* (Tul. & C. Tul.) Gilkey, *Terfezia oligosperma* Tul. & C. Tul., *Tuber asa* Tul. & C. Tul.

Macroscopic and Microscopic Features

Ascomata 25-45 mm, hypogeous, globose to subglobose, usually lobed. **Peridium** ochre to light brown. **Gleba** whitish when young, becoming grey-brown at maturity, marbled with white, branching veins, radiating from the center. **Asci** 62-83 × 65-85 µm, subglobose to ovoid, thick-walled, shortly stipitate, and 1-4 spored. **Ascospores** 24-37 × 26-38 µm, globose to broadly ellipsoid, yellowish when young, yellow-brown to brown at maturity, with reticulate-alveolate ornamentation.

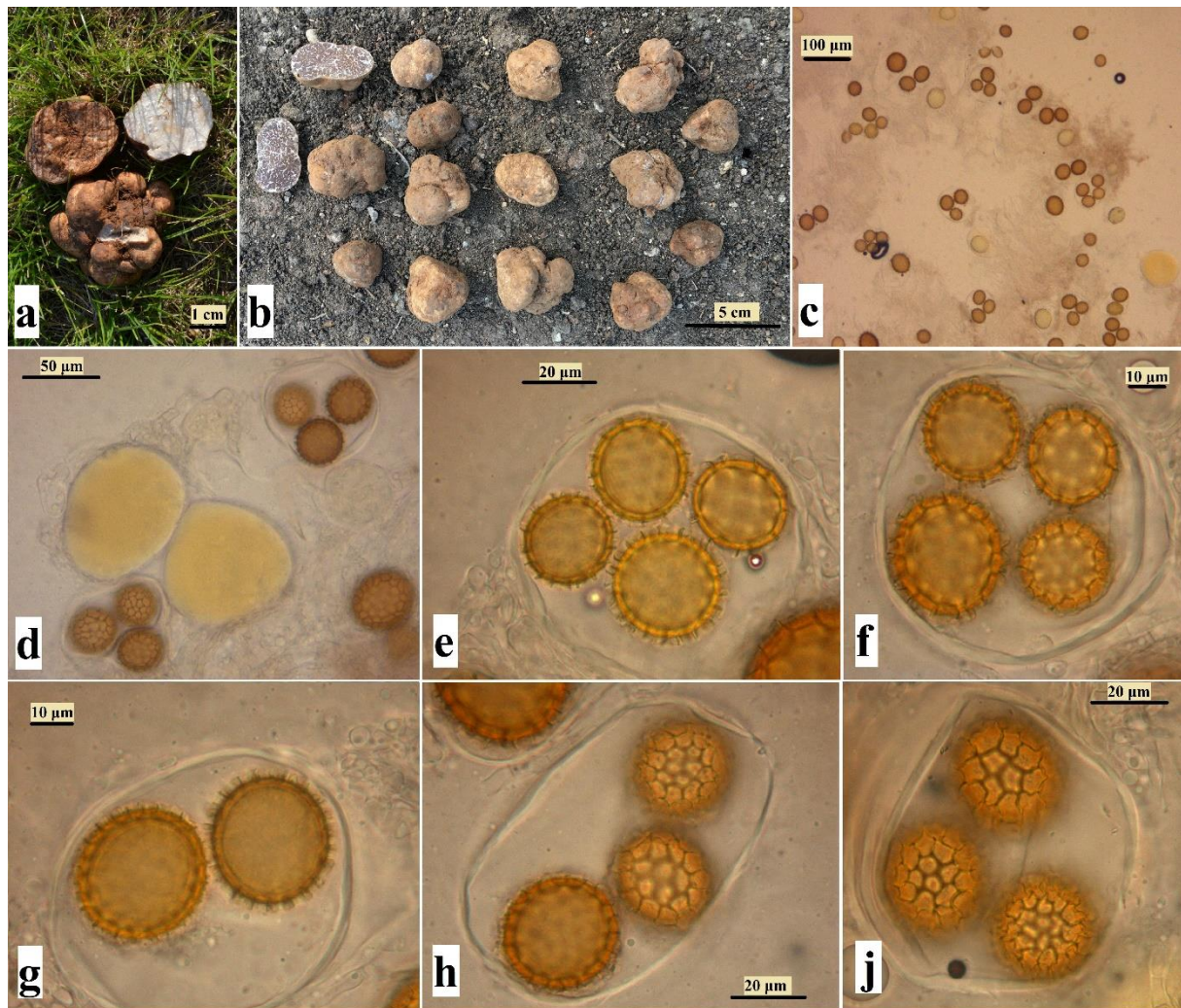


Figure 1. *Tuber oligospermum* under light microscope (LM) : a,b. ascomata b.spores. c-j. spores within ascus

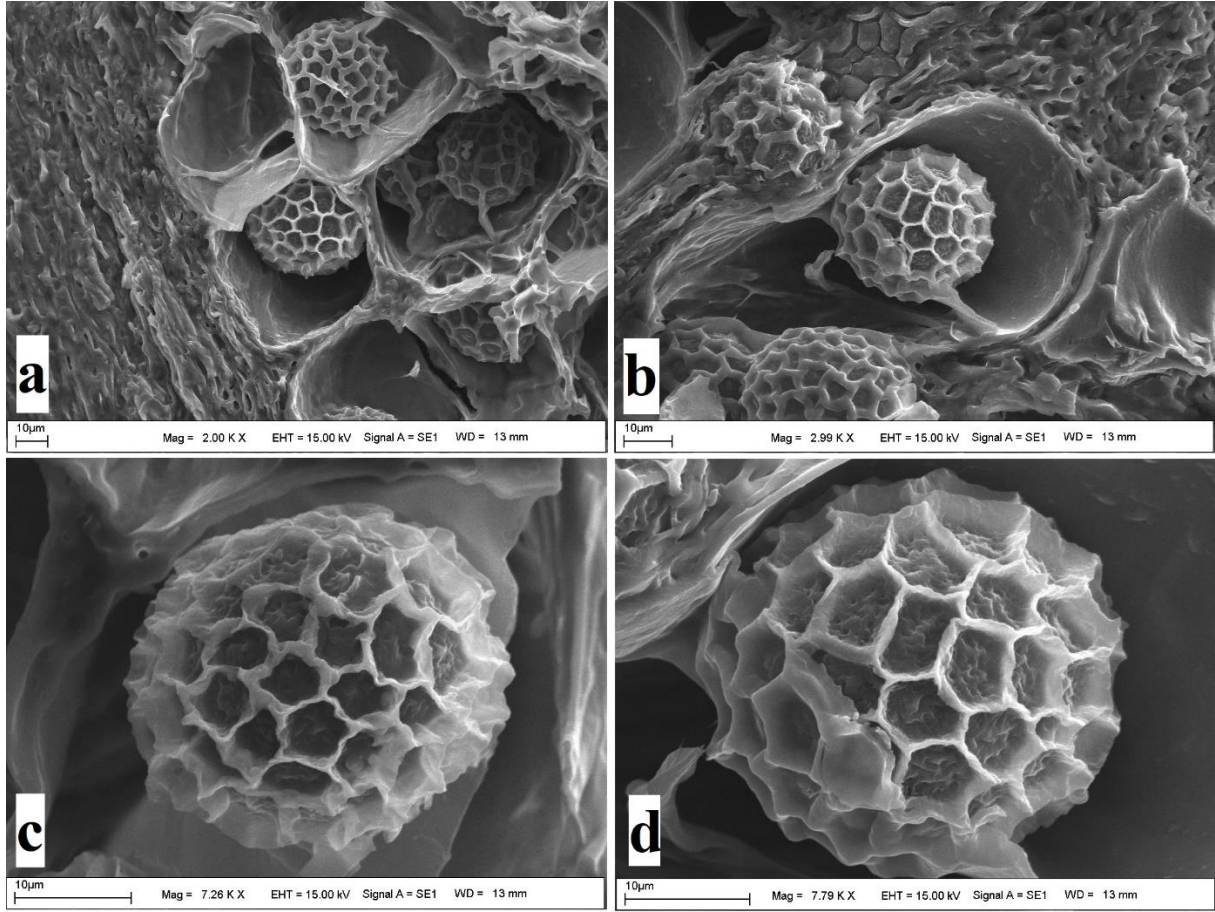


Figure 2. *Tuber oligospermum* as viewed by a scanning electron microscope (SEM): a-d. spores.

Specimen examined: Turkey-Şanlıurfa: Hilvan, under pine, 650 m, 37° 31' N, 38° 54' E, 14.04.2022, ANK Akata 8498.

- *T. puberulum* Berk. & Broome
Artvin, Aydın, Denizli, Muğla, Osmaniye, Trabzon (Elliot et al., 2016; Uzun and Yakar, 2018).

- *T. rufum* Picco.
Aydın, Antalya, Bolu, Burdur, Denizli, Kastamonu, Konya, Muğla, Osmaniye (Türkoğlu and Castellano, 2014; Türkoğlu et al., 2015).

Basidiomycota R.T. Moore

Agaricaceae Chevall.

- *Chlorophyllum lusitanicum* G. Moreno, Muñ.-Moh., Manjón, Carlavilla & Altés
İzmir (Uzun and Kaya 2022).

Albatrellaceae Nuss

- *Leucogaster liosporus* R. Hesse
Çankırı (Pilát, 1937).
- *L. luteomaculatus* Zeller & C.W. Dodge
Çankırı (Pilát, 1937).
- *L. nudus* (Hazsl.) Hollós
Çankırı, Kastamonu, Rize, Trabzon (Pilát, 1937; Türkoğlu et al., 2015; Kaya and Uzun, 2020).
- *L. tozzianus* (Cavara & Sacc.) Mattir. ex Zeller & C.W. Dodge
Kastamonu, Trabzon (Türkoğlu et al., 2015).

- *Leucophleps aculeatispora* Fogel
Kastamonu (Elliot et al., 2016).

Bolbitiaceae Singer

- *Descolea alba* (Klotzsch) Kuhar, Nouhra & M.E. Sm.
Muğla (Ünal et al., 2016).
- *Setchelliogaster tenuipes* (Setch.) Pouzar
Muğla (Ünal et al., 2016).

Boletaceae Chevall.

- *Octaviania asterosperma* Vittad.
Artvin, Bursa, Ordu, Trabzon (Türkoğlu et al., 2015; Kaygusuz et al, 2018).

- *Wakefieldia macrospora* (Hawker) Hawker
İstanbul (Uzun and Kaya, 2020b).

Cortinariaceae R. Heim ex Pouzar

- *Cortinarius olens* Gasparini
Ankara, Artvin, Kastamonu (Türkoğlu et al., 2015).

- *Protoglossum niveum* (Vittad.) T.W. May
Trabzon (Uzun and Kaya, 2022).

Geastraceae Corda

- *Schenella pityophila* (Malençon & Rioussset)
Estrada & Lado
Muğla, Konya (Doğan, 2018; Yakar et al., 2019).

Gomphaceae Donk

- *Gautieria graveolens* Vittad.
Çankırı, Rize, Trabzon (Pilát, 1937; Uzun et al., 2019a)

- *G. monticola* Harkn.
Gaziantep, Kahramanmaraş (Kaya, 2009a; Uzun et al., 2015).

- *G. morchelliformis* Vittad.
Konya (Doğan and Akata, 2015).

- *G. otthii* Trog
Bolu, Kastamonu (Türkoğlu et al., 2015).

- *G. retirugosa* Th. Fr.
Bolu (Türkoğlu et al., 2015).

- *G. trabutii* (Chatin) Pat.
Burdur, Muğla (Türkoğlu et al., 2015).

Hymenogastraceae Vittad.

- *Hymenogaster bulliardii* Vittad.
Karaman (Uzun et al., 2016).
- *H. citrinus* Vittad.
Samsun (Türkoğlu et al., 2015).
- *H. griseus* Vittad.
Muğla (Türkoğlu and Castellano, 2013).
- *H. hessei* Soehner
Kastamonu (Türkoğlu et al., 2015).
- *H. luteus* Vittad.
Isparta, İstanbul, Osmaniye, Tekirdağ, Trabzon, Yalova (Türkoğlu et al., 2015; Kaya and Uzun, 2020).
- *H. lycoperdineus* Vittad.
Isparta (Türkoğlu et al., 2015).
- *H. olivaceus* Vittad.
Denizli (Türkoğlu and Castellano, 2013).
- *H. rehsteineri* Bucholtz
Artvin, Samsun, Tekirdağ, Yalova (Elliot et al., 2016).
- *H. thwaitesii* Berk. & Broome
Denizli, Muğla, Osmaniye (Türkoğlu and Castellano, 2013; Türkoğlu et al., 2015).
- *H. vulgaris* Tul. & C. Tul.
Muğla, Samsun, Tekirdağ, Yalova (Türkoğlu and Castellano, 2013; Türkoğlu et al., 2015).

Hysterangiaceae E. Fisch.

- *Hysterangium calcareum* R. Hesse
Ordu (Elliot et al., 2016).
- *H. clathroides* Vittad.
Gaziantep, Kütahya, Trabzon (Türkoğlu et al., 2015; Uzun et al., 2015; Uzun and Kaya 2022).
- *H. epiroticum* Pacioni
Kastamonu (Türkoğlu et al., 2015).
- *H. fragile* Vittad.
Kastamonu, Ordu (Türkoğlu et al., 2015).
- *H. inflatum* Rodway
Muğla (Ünal et al, 2016).
- *H. nephriticum* Berk.
Sakarya, Trabzon (Türkoğlu et al., 2015; Uzun and Kaya 2022).
- *H. stoloniferum* Tul. & C. Tul.
Konya (Doğan and Akata, 2015).

Mesophelliaceae Jülich

- *Chondrogaster pachysporus* Maire
Muğla (Ünal et al, 2016).

Paxillaceae Lotsy

- *Alpova corsicus* P.-A. Moreau & F. Rich.
Artvin (Türkoğlu et al., 2015).
- *A. diplophloeus* (Zeller & C.W. Dodge) Trappe & A.H. Sm.
Rize, Trabzon (Yakar et al., 2019; Uzun and Kaya, 2022).
- *Melanogaster ambiguus* (Vittad.) Tul. & C. Tul.
Hakkari, Gaziantep, Muğla, Trabzon (Uzun et al., 2014; Uzun et al., 2015; Elliot et al., 2016; Uzun and Kaya, 2022).
- *M. broomeanus* Berk.
Artvin, Denizli, Erzurum, Gaziantep, Kastamonu, Samsun, Trabzon (Demirel, 1998; Türkoğlu and Castellano, 2013; Türkoğlu et al., 2015; Uzun et al., 2014; Uzun et al., 2015; Uzun and Kaya, 2022).
- *M. macrosporus* Velen.
Trabzon (Elliot et al., 2016).
- *M. variegatus* (Vittad.) Tul. & C. Tul.

Kütahya, Trabzon (Kaygusuz et al., 2018; Sesli and Moreau, 2015; Uzun and Kaya, 2022).

Phallogastraceae Locq.

- *Phallogaster saccatus* Morgan
Kastamonu (Doğan, 2006).

Rhizopogonaceae Gäum. & C.W. Dodge

- *Rhizopogon abietis* A.H. Sm.
Sakarya (Doğan et al., 2021).
- *R. luteolus* Fr.

Adana, Adıyaman, Antalya, Denizli, Eskişehir, Erzurum, Gaziantep, Isparta, İzmir, Kahramanmaraş, Kastamonu, Kayseri, Kütahya, Konya, Mersin, Tokat, Şanlıurfa (Solak et al., 1999; Gezer, 2000; Demirel et al., 2003; Kaşık et al., 2003; Öztürk et al., 2003; Türkekul, 2003; Köstekçi et al., 2005; Kaya, 2006; Köse et al., 2006; Kaya, 2009b; 2009c; Türkoğlu and Gezer, 2006; Türkoğlu et al., 2007; Akata et al., 2010; Alkan et al., 2010; Doğan et al., 2010; Güngör et al., 2015; Kaya, 2015; Doğan and Kurt, 2016; Allı et al., 2017a).

- *R. marchii* (Bres.) Zeller & C.W. Dodge
Trabzon (Sesli and Castellano, 2009).

- *R. obtectus* (Spreng.) R. Rauschert

Gümüşhane, Trabzon (Akata et al., 2016; Uzun and Kaya, 2022).

- *R. ochraceorubens* A.H. Sm.

Bolu, Kastamonu, Muğla, Yalova (Yağız et al., 2006a; 2006b; Güngör et al., 2016; Allı et al., 2017b).

- *R. roseolus* (Corda) Th. Fr.

Adana, Antalya, Bursa, Bolu, Denizli, Gümüşhane, Isparta, İzmir, Karaman, Konya, Kütahya, Mersin, Muğla, Sinop, Sivas, Yozgat (Solak et al., 1999; Gezer, 2000; Öztürk et al., 2003; Doğan and Öztürk, 2006; Köse et al., 2006; Uzun et al., 2006; Yağız et al., 2006a; 2006b; Doğan et al., 2007; Türkoğlu et al., 2007; Alkan et al., 2010; Doğan et al., 2010; Servi et al., 2010; Kırış et al., 2012; Güngör et al., 2015; Allı et al., 2016; Doğan and Kurt, 2016; Güngör et al., 2016; Allı et al., 2017a).

Russulaceae Lotsy

- *Russula candida* (Tul. & C. Tul.) J.M. Vidal
(Uzun et al., 2019b; Uzun and Kaya, 2022).

- *Russula mistiformis* (Mattir.) Trappe & T.F. Elliott

Konya (Doğan and Akata, 2015).

- *R. xanthospora* (Hawker) Trappe & T.F. Elliott
Denizli (Türkoğlu and Castellano, 2013).

- *Lactarius stephensii* (Berk.) Verbeke & Walley
Trabzon (Uzun and Kaya, 2017).

Sclerogastraceae Locq. ex P.M. Kirk

- *Sclerogaster compactus* (Tul. & C. Tul.) Sacc.
Muğla (Elliot et al., 2016).

- *S. hysterangioides* (Tul. & C. Tul.) Zeller & C.W. Dodge

Bolu (Elliot et al., 2016).

Trappeaceae P.M. Kirk

- *Trappea darkeri* (Zeller) Castellano
Niğde (Uzun et al. 2020).

Discussion

In this study, we try to lay the groundwork for future truffle research by reporting a new truffle fungus record for Turkish truffle biodiversity. For these purposes, we report *T. oligospermum* as new records for Turkey. Similarly,

104 truffle species were identified in this study, belonging to 35 genera and 20 families (4 Ascomycota and 16 Basidiomycota), whereas Şen et al. (2016) reported 67 truffle species belonging to 23 genera and 15 families.

Ascomycota accounts for 44% of truffles, while Basidiomycota accounts for 56%. (Figure 3b).

Tuber, with 12 species, is the most widely distributed genus, followed by *Hymenogaster*, with 10 species (Figure 3a).

Tuber oligospermum is a whitish, ochre-brown truffle species distinguished by its prosenchymatous peridium and oligosporous asci lacking a pedicel (Moreno-Arroya et al.,

2000). It differs from *T. borchii* and *T. puberulum* by its prosenchymatous peridium structure (Alvaro et al., 2012).

Even though *T. sphareospermum* and *T. cistophilum* have the same peridium structure, there are some microscopic and ecological differences between these two species. *Tuber sphareospermum* differs from *Tuber oligospermum* by having globose spores, whereas *Tuber cistophilum* differs by its association with *Cistus ladanifer* and having 9-12 cells in the spore reticulum (Alvaro et al., 2012).

The distribution of *T. oligospermum* is from eastern Spain to Israel and Morocco (Moreno-Arroya et al., 2000; Alvaro et al., 2012) on sandy soils.

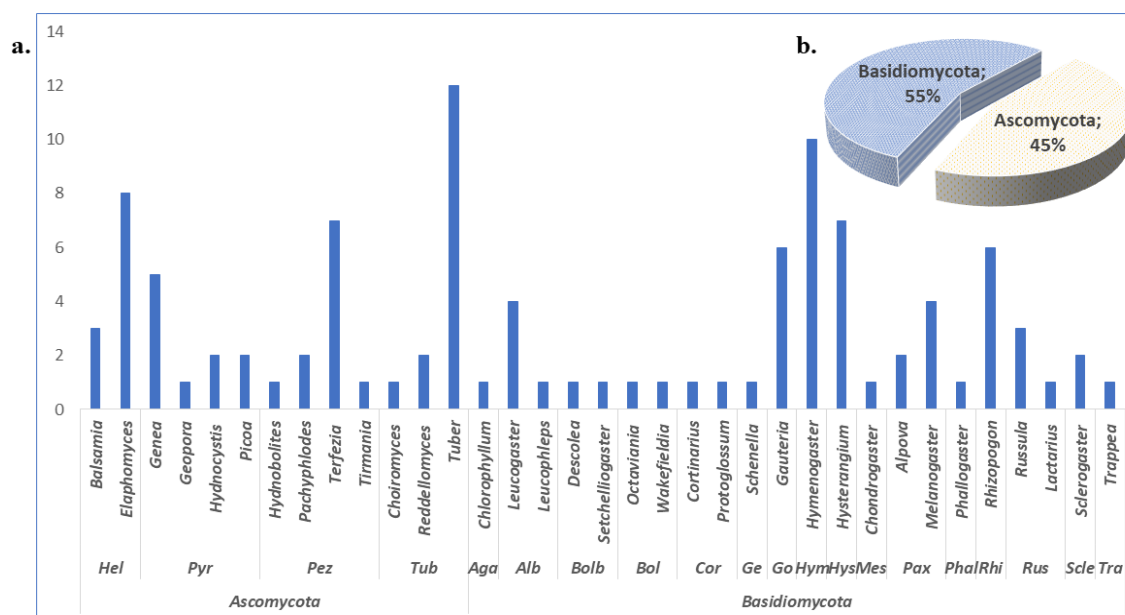


Figure 3. The distribution of truffles, a. distribution to genus, b. the percentages of the divisions.

References

- Afyon A. 1996. Isparta Yöresinde Belirlenen Bazı Makroskobik Mantarlar. Turkish Journal of Botany, 20: 161-164.
- Akata I, Çetin B, Işıloğlu M. 2010. Macrofungal Diversity of Ilgaz Mountain National Park and Its Environs (Turkey). Mycotaxon, 113: 287-290.
- Akata I, Uzun Y, Kaya A. 2016. Macrofungal Diversity of Zigana Mountain (Gümüşhane/Turkey). Biological Diversity and Conservation, 9 (2): 57-69.
- Akata I, Sevindik M, Şahin E. 2020. *Tuber fulgens* Quél. A New Record for Turkish Truffles. Turkish Journal of Agriculture - Food Science and Technology, 8(11): 2472-2475.
- Akyüz M, Kırbağ S, Bircan B. 2015a. Medical characteristics of arid-semi arid Truffle (*Terfezia* and *Picoa*) in the Elazığ-Malatya region of Turkey. Hacettepe Journal of Biology and Chemistry, 43: 301-308.
- Akyüz M, Kırbağ S, Bircan B, Gürhan Y. 2015b. Diversity and distribution of arid-semi arid truffle (*Terfezia* and *Picoa*) in Elazığ-Malatya region of Turkey. Mycosphere, 6(6): 766-783.
- Akyüz M, Kırbağ S, Gürhan Y, Bircan B. 2016. Elazığ-Malatya çevresinde yetişen *Terfezia* ve *Picoa* trüf türlerinin mikorizal ilişkileri ile in situ ve ex situ koruma durumunun tespit edilmesi. Artvin Çoruh Üniversitesi Orman Fakültesi Dergisi, 17 (1): 1-10.
- Akyüz M, Akyüz HE, Kırbağ S. 2017. Ethnomycological aspects of traditional usage and indigenous knowledge about the arid-semi arid truffles consumed by the residents of the eastern Anatolia region of Turkey. Gazi University Journal of Science, 30 (4): 57-70.
- Alkan S, Kaşık G, Aktaş S. 2010. Macrofungi of Derebucak (Konya, Turkey). Turkish Journal of Botany, 34: 335-350.
- Alkan S, Aktaş S, Kaşık G. 2018. Türkiye'deki *Tuber* Türleri ve *Tuber aestivum* İçin Yeni Bir Lokalite. Selçuk Üniversitesi Fen Fakültesi Fen Dergisi, 44 (1): 25-29.
- Allı H, Şen İ, Altuntaş D. 2016. Macrofungi of İznik Province. Communications Faculty of Sciences University of Ankara Series C Biology, 25 (1-2): 7-24.
- Allı H, Çöl B, Şen İ. 2017a. Macrofungi biodiversity of Kütahya (Turkey) province. Biological Diversity and Conservation, 10 (1): 133-143.
- Allı H, Candar SS, Akata I. 2017b. Macrofungal diversity of Yalova province. Mantar Dergisi, 8 (2): 76-84.
- Allı H, Doğan HH. 2019. A new genus (*Balsamia*) addition for Turkish mycota. Mantar Dergisi, 10 (1): 23-25.
- Alvaro P, Moreno G, Manjón JL. 2012. Comparison between *Tuber gennadii* and *T. oligospermum* lineages reveals the existence of the new species *T. cistophilum* (Tuberaceae, Pezizales). Mycologia, 104 (4): 894-910.

- Berber O, Uzun Y, Kaya A. 2019. *Genea lobulata*, A New Hypogeous Ascomycete Record for Turkish Mycobiota. Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü Dergisi, 23 (3): 922-924.
- Bonito GM, Smith ME. 2016. General Systematic Position of the Truffles: Evolutionary Theories. In: Zambonelli A, Iotti M, Murat C (editors). True Truffle (*Tuber* spp.) in the World. Switzerland, Springer. pp. 3-18.
- Castellano MA, Türkoğlu A. 2012. New Records of Truffle Taxa in *Tuber* and *Terfezia* from Turkey. Turkish Journal of Botany, 36: 295-298.
- Davis PH, Harper PC, Hedge IC. 1971. Plant Life of South-West Asia. Edinburgh, UK: The Botanical Society of Edinburgh.
- Demir S, Demirel K, Uzun Y. 2007. Macrofungi of Batman province. Ekoloji, 16 (64): 37-42.
- Demirel K, Kaya A, Uzun Y. 2003. Macrofungi of Erzurum Province. Turkish Journal of Botany, 27: 29-36.
- Demirel K. 1998. Two New Records for the Mycoflora of Turkey. YYÜ. Fen Edebiyat Fakültesi Fen Bilimleri Dergisi, 5: 22-25.
- Doğan HH. 2006. The first locality of *Phallogaster saccatus* (*Hysterangiaceae*) in Turkey. Mikologia i Fitopatologia 40 (1): 22-24.
- Doğan HH. 2018. A new genus, *Schenella*, addition to Turkish mycota from *Geastraceae*. Mantar Dergisi, 9(2): 92-94.
- Doğan HH. 2021. A new truffle species addition, *Tuber macrosporium* Vittad., to Turkish mycota. Trakya University Journal of Natural Sciences, 22(2): 139-146.
- Doğan HH, Öztürk C. 2006. Macrofungi and Their Distribution in Karaman Province, Turkey. Turkish Journal of Botany, 30: 193-207.
- Doğan HH, Akata I. 2015. New Additions to Turkish Gasteroid Fungi. Kastamonu Üniversitesi Orman Fakültesi Dergisi, 15 (2): 329-333.
- Doğan HH, Kurt F. 2016. New Macrofungi Records from Turkey and Macrofungi Diversity of Pozantı-Adana. Turkish Journal of Botany, 40: 209-217.
- Doğan HH, Öztürk C, Kaşık G, Aktaş S. 2007. Macrofungi Distribution of Mut Province in Turkey. Pakistan Journal of Botany, 38(1): 293-308.
- Doğan HH, Küçük MA, Akata I. 2010. A Study on Macrofungi Diversity of Bozyazı Province (Mersin), Turkey. Gazi University Journal of Science, 23 (4): 393-400.
- Doğan HH, Bozok F, Taşkın H. 2018. A new species of *Barssia* (*Ascomycota, Helvellaceae*) from Turkey. Turkish Journal of Botany, 42 (5): 636-643.
- Doğan HH, Öztürk Ö, Aydın MA. 2021. The Mycobiota of Samanlı Mountains In Turkey. Trakya University Journal of Natural Sciences, 22(2): 215-243.
- Dündar A, Yeşil OF, Acay H, Okumuş V, Özdemir S, Yıldız A. 2012. Antioxidant properties, chemical composition, and nutritional value of *Terfezia boudieri* (Chatin) from Turkey. Food Science and Technology International, 18(4): 317-328.
- Elliot TF, Türkoğlu A, Trappe MT, Yaratankul Güngör M. 2016. Turkish Truffles 2: Eight New Records from Anatolia. Mycotaxon, 131: 439-453.
- Gezer K. 2000. Contributions to the Macrofungi Flora of Antalya Province. Turkish Journal of Botany, 24: 293-298.
- Gezer K, Kaygusuz O, Çelik A, Işıloğlu M. 2014. Ecological Characteristics of Truffles Growing in Denizli Province, Turkey. Journal of Food, Agriculture & Environment, 12: 1105-1109.
- Gücin F. 1990. Elazığ Çevresinde Belirlenen Makrofunguslar. Doğa Türk Botanik Dergisi, 14 (3): 171-177.
- Gücin F, Kaya A, Soylu MK, Uzun Y. 2010. *Picoa* Vittad., A New Truffle Genus Record for Turkey. Biological Diversity and Conservation, 3 (3): 23-25.
- Güngör H, Solak MH, Allı H, Işıloğlu M, Kalmış E. 2015. New Records for Isparta and Contributions to the Macrofungi Diversity of Isparta Province. Turkish Journal of Botany, 39: 867-877.
- Güngör H, Solak MH, Allı H, Işıloğlu M, Kalmış E. 2016. Contributions to the macrofungal diversity of Hatay province, Turkey. Biological Diversity and Conservation 9(1): 101-106.
- İnci Ş, Kırbag S. 2018. *Terfezia claveryi* Chatin'in besinsel içeriği, antioksidan ve antimikrobiyal aktivitesi. Artvin Çoruh Üniversitesi Orman Fakültesi Dergisi, 19 (2): 138-143.
- Işıloğlu M, Öder N. 1995. Malatya Yöresinin Makrofungusları. Turkish Journal of Botany, 19: 321-324.
- Kagan-Zur V, Akyüz M. 2014. Asian Mediterranean Desert Truffles. In: Kagan-Zur V, Roth-Bejerano N, Sitrit Y, Morte A (editors). Desert Truffles, Phylogeny, Physiology, Distribution and Domestication. London: Springer. ISBN 978-642-40096-4 (eBook).
- Kaşık G, Öztürk C, Akkoz C, Doğan HH. 1998. S. Ü. Alaaddin Keykubat Kampüsünde Belirlenen Bazı Makrofunguslar. Selçuk Üniversitesi Fen-Edebiyat Fakültesi Dergisi, 15: 87-99.
- Kaşık G, Öztürk C, Toprak E. 2001. Macrofungi of Niğde Province (Turkey). Ot Sistematik Botanik Dergisi, 8 (2): 137-142.
- Kaşık G, Öztürk C, Türkoğlu A, Doğan HH. 2003. Macrofungi of Yahyalı (Kayseri) Province. Turkish Journal of Botany 27: 453-462.
- Kaya A. 2006. Macrofungi of Andırın (Kahramanmaraş) District. Turkish Journal of Botany, 30: 85-93.
- Kaya A. 2009a. Macromycetes of Kahramanmaraş Province (Turkey). Mycotaxon, 108: 31-34.
- Kaya A. 2009b. Macrofungi Diversity of Nemrut Mount National Park and its Environs (Adıyaman – Turkey). African Journal of Biotechnology, 8 (13): 2978-2983.
- Kaya A. 2009c. Macrofungi of Huzurlu High Plateau (Gaziantep-Turkey). Turkish Journal of Botany, 33: 429-437.
- Kaya A. 2015. Contributions to the Macrofungi Diversity of Atatürk Dam Lake Basin. Turkish Journal of Botany, 39: 162-172.
- Kaya A, Demirel K, Uzun Y. 2012. Macrofungi Diversity of Araban (Gaziantep/Turkey) District. Biological Diversity and Conservation, 5(3): 162-166.
- Kaya A, Uzun Y. 2020. New locality records for two truffle taxa in Turkey. Türler ve Habitatlar, 1 (2): 58-65.
- Kaygusuz O, Çolak ÖF, Matočec N, Kušan I. 2018. New data on Turkish hypogeous fungi. Natura Croatica, 27: 257-269.
- Kırış Z, Halıcı MG, Akata I, Allı H. 2012. Macrofungi of Akdağmadeni (Yozgat/Turkey) and Gemerek (Sivas/Turkey). Biological Diversity and Conservation 5(2): 53-58.
- Köse S, Gezer K, Gökler İ, Türkoğlu A. 2006. Macrofungi of Bekilli (Denizli) District. Turkish Journal of Botany, 30: 267-272.
- Köstekçi H, Yamaç M, Solak MH. 2005. Macrofungi of Türkmenbaba Mountain (Eskişehir). Turkish Journal of Botany, 29: 409-416.
- Largent D, Johnson D, Watling R. 1977. How to Identify Mushrooms to Genus III, Microscopic Features. Eureka, CA, USA: Mad River Press Inc.
- Moreno-Arroyo B, Infante F, Pulido E, Gómez J. 2000. The biogeography and taxonomy of *Tuber oligosporum* (Tul. & C. Tul.) Trappe (Ascomycota). Cryptogamie Mycology, 21 (3): 147-152.
- Mueller GM, Schmit JP, Leacock PR, Buyck B, Cifuentes J, Desjardin DE, Halling RE, Hjortstam K, Iturriaga T, Larsson KH, Lodge DJ, May TW, Minter D, Rajchenberg M, Redhead SA, Ryvarden L, Trappe JM, Watling R, Wu Q. 2007. Global Diversity and Distribution of Macrofungi. Biodivers Conserv, 16: 37-48.
- Öder N. 1988. Taxonomic Investigations of Important Edible and Poisonous Mushrooms Growing in The Konya Center and Some Districts of Konya. Selçuk Üniversitesi Fen Edebiyat Fakültesi Dergisi, 8: 237-257.

- Özderin S, Yılmaz F, Allı H. 2018. Determining mycorrhiza rate in some oak species inoculated with *Tuber aestivum* Vittad. (summer truffle). Türkiye Ormançılık Dergisi, 19 (3): 226-232.
- Öztürk C, Kaşık G, Toprak E. 1997. Ascomycetes Makrofunguslarından Türkiye İçin İki Yeni Kayıt. Ot Sistematik Botanik Dergisi 4: 53-56.
- Öztürk C, Kaşık G, Doğan HH, Aktaş S. 2003. Macrofungi of Alanya District. Turkish Journal of Botany, 27: 303-312.
- Pilát AA. 1937. Additamenta ad Floram Asiae Minoris Hymenomycetum et Gasteromycetum. Bulletin Trimestriel Society Mycologie France, 53: 253-264.
- Sahin E, Keskin E, Akata I. 2021. Novel and diverse mycoviruses co-inhabiting the hypogeous ectomycorrhizal fungus *Picoa juniperi*. Virology, 552: 10-19.
- Servi H, Akata I, Çetin B. 2010. Macrofungal diversity of Bolu Abant Nature Park (Turkey). African Journal of Biotechnology, 9(24): 3622-3628.
- Sesli E, Castellano MA. 2009. *Rhizopogon marchii* (Basidiomycota, Rhizopogonaceae), A New Record from Turkey. Ot Sistematik Botanik Dergisi, 16: 155-158.
- Sesli E, Moreau PA. 2015. Taxonomic Studies on Some New Fungal Records from Trabzon, Turkey. Turkish Journal of Botany, 39: 857-866.
- Sesli E, Asan A, Selçuk F (eds), Abacı Günyar Ö, Akata I, Akgül H, Aktaş S, Alkan S, Allı H, Aydoğdu H, Berikten D, Demirel K, Demirel R, Doğan HH, Erdoğan M, Ergül CC, Eroğlu G, Giray G, Halikî Uztan A, Kabaktepe Ş, Kadaifçiler D, Kalyoncu F, Karaltı İ, Kaşık G, Kaya A, Keleş A, Kırbağ S, Kıvanç M, Ocak İ, Ökten S, Özkale E, Öztürk C, Sevindik M, Şen B, Şen İ, Türkekül İ, Ulukapı M, Uzun Ya, Uzun Yu, Yoltaş A. 2020. Türkiye Mantarları Listesi. İstanbul: Ali Nihat Gökyiğit Vakfı Yayını.
- Sevindik M, Pehlivan M, Doğan M, Selamoğlu Z. 2018. Phenolic content and antioxidant potential of *Terfezia boudieri*. Gazi University Journal of Science, 31(3): 707-711.
- Solak MH, Işiloğlu M, Gücin F, Gökler İ. 1999. Macrofungi of İzmir Province. Turkish Journal of Botany, 23: 383-390.
- Solak MH, Gücin F, Işiloğlu M, Pacioni G. 2003. A new record of *Geopora cooperi* f. *cooperi* from West Asia. Pakistan Journal of Botany, 35: 473-475.
- Şen İ, Allı H, Civelek HS. 2016. Checklist of Turkish truffles. Turkish Journal of Life Sciences, 1 (2): 103-109.
- Trappe JM, Molina R, Luoma DL, Cázares E, Pilz D, Smith JE, Castellano MA, Miller SL, Trappe MJ. 2009. Diversity, Ecology, and Conservation of Truffle Fungi in Forests of Pacific Northwest. United States Department of Agriculture – USDA: General Technical Report.
- Türkekül İ. 2003. A Contribution to the Fungal Flora of Tokat Province. Turkish Journal of Botany, 27: 313-320.
- Türkoğlu A. 2015. Yeraltındaki Gizli Hazine: Trüf Mantarları. T.C. Orman ve Su İşleri Bakanlığı Orman Genel Müdürlüğü, Ankara.
- Türkoğlu A, Gezer K. 2006. Hacer Ormanı (Kayseri)'nin Makrofungusları. Ekoloji, 15: 43-48.
- Türkoğlu A, Yağız D. 2012. Contributions to the Macrofungal Diversity of Uşak Province. Turkish Journal of Botany, 36: 580-589.
- Türkoğlu A., Castellano M.A. (2013): New Records of Truffle Fungi (Basidiomycetes) from Turkey. Turkish Journal of Botany, 37: 970-976.
- Türkoğlu A, Castellano MA. 2014. New Records of Some Ascomycete Truffle Fungi from Turkey. Turkish Journal of Botany, 38: 406-416.
- Türkoğlu A, Kanlık A, Gezer K. 2007. Macrofungi of Çamlık District (Denizli-Turkey). Turkish Journal of Botany, 31: 551-557.
- Türkoğlu A, Castellano MA, Trappe JM, Yaratankul Güngör M. 2015. Turkish truffles I: 18 new records for Turkey. Turkish Journal of Botany, 39(2): 359-376.
- Uzun Y. 2021. *Elaphomyces anthracinus*, a new hypogeous ascomycete record for Turkish mycota. Anatolian Journal of Botany, 5 (1): 29-31.
- Uzun Y, Kaya A. 2017. A Hypogeous *Lactarius* sp., new to Turkish mycobiota. Mantar Dergisi, 8 (2): 163-167.
- Uzun Y, Kaya A. 2018. First records of Hydnobolites and Pachyphlodes species from Turkey. Mycotaxon, 133: 415-421.
- Uzun Y, Yakar S. 2018. New locality records for two *Tuber* species in Turkey. Anatolian Journal of Botany, 2 (2): 88-92.
- Uzun Y, Kaya A. 2019a. *Elaphomyces granulatus*, a new hypogeous ascomycete record for Turkey. KSU Journal of Agriculture and Nature, 22 (1): 85-88.
- Uzun Y, Kaya A. 2019b. A new *Elaphomyces* record for Turkey. Mantar Dergisi 10 (1): 40-43.
- Uzun Y, Kaya A. 2019c. New Additions to Turkish Pezizales from the Eastern Black Sea Region. Turkish Journal of Botany 43: 262-270.
- Uzun Y, Kaya A. 2020a. *Elaphomyces citrinus* and *E. cyanosporus*, new for Turkey. Mycotaxon, 135: 339-344.
- Uzun Y, Kaya A. 2020b. *Wakefieldia*, a new hypogeous basidiomycete genus record for Turkey. Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi, 23(1): 168-171.
- Uzun Y, Kaya A. 2021. First Record of *Elaphomyces decipiens* for the Mycobiota of Turkey. Mantar Dergisi, 12(2): 134-137.
- Uzun Y, Kaya A. 2022. Macrofunges Determined in Tonya (Trabzon) District. Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi, 25(1): 66-77.
- Uzun Y, Kaya A. 2022. A New Record and a New Locality for the Genus *Chlorophyllum* Massei in Turkey. Kahramanmaraş Sütçü İmam Üniversitesi Tarım ve Doğa Dergisi, 25 (1): 144-149.
- Uzun Y, Keleş A, Demirel K. 2006. Contributions to the Macrofungi Flora of Gümüşhane Province. Turkish Journal of Botany, 30: 39-46.
- Uzun Y, Acar İ, Akata I. 2014. Notes on Turkish Melanogaster. Ot Sistematik Botanik Dergisi, 21 (2): 113-118.
- Uzun Y, Kaya A, Karacan İH, Kaya ÖF, Yakar S. 2015. Macrofunges Determined in İslahiye (Gaziantep/Turkey) District. Biological Diversity and Conservation, 8(3): 209-217.
- Uzun Y, Çetinkaya A, Kaya A. 2016. Two New Hypogeous Species Records for Turkish Macromycota from Ayrançı and Yeşildere (Karaman) Districts. 4th International Symposium on Development of Kop Region, Karaman - Turkey / October 21-23, 2016, 182-185.
- Uzun Y, Yakar S, Karacan İH, Kaya A. 2018. New additions to the Turkish *Pezizales*. Turkish Journal of Botany, 42 (3): 335-345.
- Uzun Y, Yakar S, Kaya A. 2019a. Rediscovery of *Gautieria graveolens* in Turkey. Mantar Dergisi, 10 (2): 129-132.
- Uzun Y, Kaya A, Yakar S. 2019b. A New Record and New Localities for the Genus *Sclerogaster* R. Hesse in Turkey. Süleyman Demirel University Journal of Natural and Applied Sciences, 23: 9-12.
- Uzun Y, Berber O, Kaya A. 2020. First record of *Trappea darkeri* from Turkey. Mycotaxon 135(3): 613-616.
- Ünal G, Türkoğlu A, Yaratankul Güngör M. 2016. Muğla yöresindeki *Eucalyptus* ormanlarında yetişen makrofunguslar üzerine taksonomik çalışmalar. Türk Tarım-Gıda Bilim ve Teknoloji Dergisi, 4(3): 244-247.
- Yakar S, Uzun Y, Çevik FT. 2019. New locality records for two hypogeous basidiomycete species in Turkey. Anatolian Journal of Botany, 3(1): 28-33.
- Yıldız A, Ertekin AS. 1997. Contribution to the Macrofungal Flora of Diyarbakır. Turkish Journal of Botany, 21: 119-122.
- Yılmaz Ersel F, Solak MH. 2004. Contributions to the Macrofungi of İzmir Province. Turkish Journal of Botany, 28: 487-490.