Fl. Medit. 24: 239-245
doi: 10.7320/FlMedit24.239
Version of Record published online on 30 December 2014

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New distributive and ecological data on *Tuber magnatum* (*Tuberaceae*) in Italy

Abstract

Vasquez, G., Gargano M.L., Zambonelli, A. & Venturella G.: New distributive and ecological data on *Tuber magnatum* (*Tuberaceae*) in Italy. — Fl. Medit. 24: 239-245. 2014. — ISSN: 1120-4052 printed, 2240-4538 online.

The recent discovery of natural truffle grounds of the prized *Tuber magnatum* Pico in Sicily (southern Italy) allows to up-to-date the ecology and distribution of this choice edible mushroom in Italy and opens new economic opportunities in rural areas traditionally suffering from the economic point of view. The two new localities reported expand the southern range border of the species in Italy and Europe.

Key words: white truffle, ecology, distribution, exploitation.

Introduction

Distributional and ecological information about *Tuber* species is usually very limited in mycological studies. Detection of such hypogeous fungi in Italy is only possible using dogs trained (Venturella & al. 2011) and in accordance with the rules laid down in the National Law 16 December 1985, no. 752.

Tuber magnatum is considered a typically Italian truffle. However it is also present in some restricted areas of Croatia (Bragato & al. 2004), Switzerland (Ticino), Slovenia, Serbia, Romania and Hungary (Bratek & al. 2007; Hall & al. 1998). In Italy *T. magnatum* grows mainly in Piedmont, Marche, Tuscany, Emilia Romagna, Abruzzo and Molise but was also found in Liguria, Umbria, Lazio, Veneto, Campania and Basilicata (Zambonelli & al. 2012).

For several years, research on the white truffles in Italy have been extended also to the southern regions in search of new natural truffle grounds to be exploited for economic purposes. A particular attention has been paid to the territory of Sicily and the forest ecosystems that, for floristic composition and soil type, are similar to those of growth of white truffles in northern and central Italy. According to Zambonelli & al. (2014) the current number of *Tuber* species in Sicily is 14. In particular the edible truffles *Tuber aestivum* Vittad, *T. borchii* Vittad., *T. macrosporum* Vittad. and, *T. mesentericum* Vittad. were recorded by Venturella & Bencivenga (1999), Venturella & al.

(2004) and Venturella & al. (2006) in different forest ecosystems of Sicily. This paper deals with the first finding of *T. magnatum* in Sicily that allows to provide an updated overview on the distribution and ecology of this species in Italy and Europe too. Preliminary considerations on the economic potential that its exploitation could represent for the truffle market in Italy are also provided.

Materials and methods

The truffles hunting were made in different seasons of the year 2013 with dogs trained. We visited randomly different forest ecosystems of the Sicilian territory. The morphological analysis was based on fresh ascomata and was performed in the Laboratory of Mycology of the Department of Agricultural and Forest Sciences (University of Palermo, Italy). The macroscopic and microscopic features were evaluated according to Trappe & Castellano (1991) with a Leica MS5 binocular microscope and a Leica DLMB microscope using tap water. In particular we evaluate the truffle surface, the flesh, the characteristics of fertile and sterile veins, the size and shape of asci and of ascospores and, the ascospores ornamentation. Species identification was carried out on the basis of the Tuberkey (Zambonelli & al. 2000) and of Italian truffle monographies (Montecchi & Sarasini, 2000; Ceruti & al. 2003). The dried herbarium specimens are kept in the Herbarium SAF of the Department of Agricultural and Forest Sciences (University of Palermo, Italy), in the Herbarium of the Associazione Micologica Bresadola (group of Catania, Sicily) and the personal herbarium of one of the authors (G. Vasquez). Herbarium samples are also available in the Laboratory of Mycology of the Department of Agricultural Sciences in Bologna (CMI-Unibo). The nomenclature of truffles follow Index Herbariorum while the nomenclature of vascular plants is referred to IPNI (International Plant Names Index).

Results

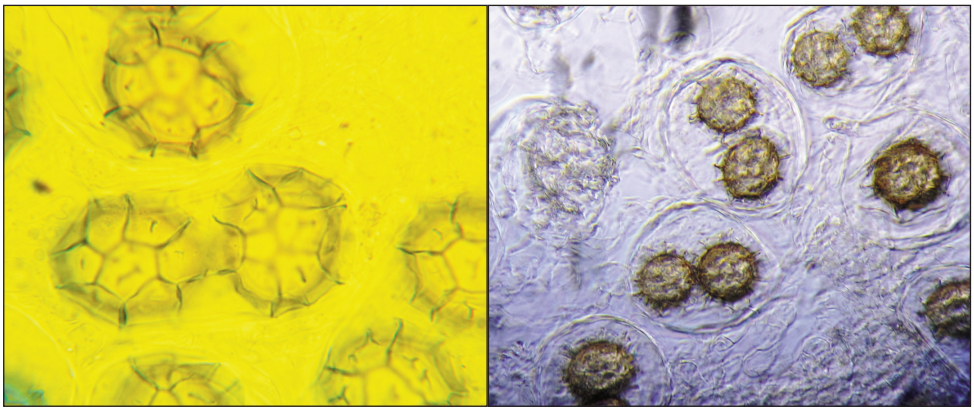
Ascomata of *Tuber magnatum* (Figs. 1-3) were found in the southern slopes of Monti Erei, a mountain chain located in the province of Enna (central Sicily) (Fig. 4). On 10 November 2013, ripe ascomata of *T. magnatum* were collected by G. Vasquez in Vallone Contrada Leano, belonging to the municipality of Piazza Armerina, in a wood of *Populus alba* L. mixed to *Corylus avellana* L., *Quercus virgiliana* Ten. and, *Eucalyptus camaldulensis* Dehnh. The natural white truffle ground is located at 610 m a.s.l. on sand-silty soil with a pH of 7.5. Another white truffle ground was discovered by G. Vasquez on 23 October 2013 in Contrada Bosco di Bubudello (670 m a.s.l.), belonging to the municipality of Enna, in a wood, evolved on sand-silty soil with a pH of 7.3, of *Populus alba* L. mixed to *Quercus cerris* L., *Q. ilex* L. and, *Q. pubescens* Willd. with shrubs of *Cistus salvifolius* L. and *C. creticus* L. in the groundcover (Fig. 5). The two localities are characterized by a typically Mediterranean climate and particularly to the thermo-Mediterranean and meso-Mediterranean types (Walter & Lieth 1960) with a dry period of 4-5 months. The natural white truffle grounds are close to the weather station of Piazza Armerina (697 m a.s.l.) which reports a mean monthly temperature of 14.9 and a mean monthly rainfall

Fig. 1. Ascoma of *T. magnatum* (photo G. Vasquez).

of 678.0 mm. According to De Martonne (1926) the aridity index (IDM) is 27.2. In the two localities of growth of *T. magnatum* an important role in overcoming the prolonged dry period is played by the presence of a permanent water table at the free surface with a depth varying between 40 and 60 meters.

Discussion

The discovery of two new productive localities of *T. magnatum* represent an important result suitable for scientific studies and the exploitation of the resource "truffle" in



Figs. 2-3. Ascospores of *T. magnatum* (100×) in cotton blue stain (photo M. Dollo, left) and in water (40×) (photo G. Vasquez, right).

Fig. 4. Localities of growth of *T. magnatum* in Sicily.

Fig. 5. Habitat of *T. magnatum*: reaforestation with *Populus alba* (photo G. Vasquez).

Italy. That assumes particular relevance in a local context such as that of the Italian territory characterized by a more frequent hydro-geological instability and a progressive loss of environmental resources, with serious repercussions also from the economic point of view. The new findings take value from the point of view of ecology and distribution of white truffles at European level. In fact it is known that *T. magnatum* is a species of limited geographical distribution (Mello & al. 2005) and, recently, some authors also highlighted the importance to establish the southernmost and northernmost borders of white truffle grounds in different countries (Bratek & al. 2007; Figliuolo & al. 2013; Pomarico & al. 2007; Puliam 2000). The two white truffle grounds located in the Sicilian inland expand the southern range border of the species in Italy and Europe. The new findings also contribute to broaden the knowledge on the ecology of *T. magnatum* in Italy. It could be useful also for claryfing the obscure points regarding its symbiotic relationships (Leonardi & al. 2013). The inland areas of Sicily are usually characterized by clay soils while in the white truffle grounds of Vallone Contrada Leano and Contrada Bosco di Bubudello the soils are looser with a mixed composition of sand and silt. The soil type is therefore different from the marly limestone and marly-clay soil type of northern Italy which are considered suitable for the growth of *T. magnatum*. The soils of the Sicilian localities of *T. magnatum* are more similar to those of upper Sinni area (Serrapotamo) in Basilicata (southern Italy) reported by Figliuolo & al. (2013). In Vallone Contrada Leano the vegetation is not very different from that other Italian regions and the presence of non-native species (i.e. *Eucalyptus camaldulensis*) does not adversely affect the growth of the white truffle as is the case in some white truffle grounds of Emilia Romagna (Zambonelli & al. 2014). The plant species composition of Contrada Bosco di Bubudello instead highlights the adaptability of the white truffle also to the arid Mediterranean environment for the presence of evergreen or semi-evergreen trees and shrubs mixed to *Populus alba* and *Quercus cerris*.

The discovery of natural truffle grounds of the prized *T. magnatum* in Sicily also opens new economic opportunities in rural areas traditionally suffering from the economic point of view. In fact it is known that the discovery of new species of edible mushrooms and/or the characterization of critical taxonomic groups can provide important perspectives from the economic and the industrial point of view (Stadler & al. 2004; Venturella & al. 2002; Zotti & al. 2013). The collection and trading of truffles as well as the cultivation of choice species could contribute at providing valuable solutions both in financial and environmental terms (Varese & al. 2011).

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