

The Mysteries of the White Truffle: Its Biology, Ecology and Cultivation

Subjects: Toxicology

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Tuber magnatum Picco is the most expensive of the truffles and a great deal of research has been carried out in an attempt to solve the mysteries of its ecology and biology. However, considerable work remains to be done particularly on those secrets of its life cycle that remain a mystery. It is known that *T. magnatum* is heterothallic, but it has yet to be determined how fertilization occurs between the two strains of different mating types. It is also known that the white truffle is an ectomycorrhizal fungus, and its mycorrhizas can be produced in greenhouses, but then they seem to disappear in the field. The role of other soil microorganisms, fungi and bacteria, on its soil mycelial development and fructification is intriguing but is far from being completely understood. All these uncertainties have made the cultivation of *T. magnatum* extremely difficult and only recently have we had the scientific proofs that it is possible. Even so, many questions remain unanswered and the management practices of *T. magnatum* plantations are still to be better defined to also enable the taming of this truffle.

Keywords: *Tuber magnatum* ; biological and ecological aspects ; aroma ; microbiome ; mycorrhizas

Truffles are fleshy ascomycetous fungi that generally fruit underground. The spores are sequestered in the fruiting body (the ascoma or ascocarp), which consists of a more or less subspherical mass. Many researchers prefer to consider as “true truffles” only the Ascomycota in the genus *Tuber* belonging to the Tuberaceae family and in the order Pezizales [1]. There are more than 180 species, all characterized by an ectomycorrhizal habit and naturally are mostly restricted to the Northern Hemisphere [2]. The phylogeny of the genus has been studied by many authors [3][4][5] with the most recent by Bonito et al., 2013 [2], which provided a complete phylogenetic analysis of the genus and its recognized 11 main clades: *Aestivum*, *Rufum*, *Excavatum*, *Gibbosum*, *Japonicum*, *Puberulum*, *Macrosporum*, *Maculatum*, *Multimaculatum*, *Melanosporum* and *Gennadii*. Although all the *Tuber* species are edible, only four are considered culinary delicacies and command really high prices: *Tuber melanosporum* Vittad. (Périgord black truffle) in the *Melanosporum* clade, *Tuber borchii* Vittad. (Bianchetto truffle) in the *Puberulum* clade, *Tuber magnatum* Picco (Italian white truffle) and *Tuber aestivum* Vittad. (Burgundy truffle) which are both included in the *Aestivum* clade.

Undoubtedly, *T. magnatum* ranks above the others because of its intense aroma and unique flavor. As a consequence, Italian retail prices for *T. magnatum* are higher than for any other truffle and make it one of the world's most expensive foods [6], with prices ranging from 1000 to 6000 EUR kg⁻¹ [7] and a business of about 0.9 billion EUR year⁻¹ [8].

In poor production years such as 2007 and 2021 [9], when dry summers reduced production, prices reached 7000 EUR kg⁻¹, and outside of Italy in upmarket stores such as Harrods in London, prices reached dizzying heights. In this entry, the distinctive morphological characters of this truffle are described as well as its biology and ecology. The current status of its cultivation is reported, which emphasizes the gaps in our knowledge that actually limit the possibility of taming this truffle in contrast to the other European species of *Tuber*.

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