

ECONOMICALLY AND ALIMENTARY IMPORTANT TRUFFLE SPECIES, ESTABLISHMENT AND DEVELOPMENT OF THE TRUFFLE CULTURE IN XIROMERO REGION

Chetan Simona Claudia, G. Morar

University of Agricultural Sciences and Veterinary Medicine of Cluj Napoca

Abstract. *Subterranean Fungi of the genus Tuber live and grow only in symbiosis, with certain trees or plants roots (various species of oak, hazel, pine, linden, poplar, juniper, etc.), requiring specific pedoclimatic conditions. The truffle is a plant product, particularly rich in nitrogen, minerals, lipids, carbohydrates, organic acids, cellulose, colored substances, etc. Among the numerous existing species of truffle, just some of them are economically and alimentary important, such as: white truffle (Tuber magnatum), black truffle (Tuber melanosporum), the summer truffle (Tuber aestivum), whitish truffle (Tuber borchii), Tuber uncinatum etc. Establishment of truffle plantations can be achieved only with inoculated seedlings in specialized nurseries and under controlled conditions. Seedling inoculation is done through several methods, depending on the spores of the truffle species used, but also on the host plant species used.*

Keywords: description of certain truffle species, establishment of the truffle culture, comparison of plant growth and development depending on conditions of irrigation and maintenance.

INTRODUCTION

The truffle culture established either in natural forests or in the specially cultivated ones, is a significant income for the economy in the mountain and submountain regions, whose development has several purposes: production of forest products, protection of natural environment, landscape, forest areas and first of all obtaining truffle production. There are over 50 species of truffle species and if we add to these the species that do not belong to the genus Tuber, but which form underground fructifications, similar to truffles, their number goes much above 100. Only about 10 species of all these are important and only a few of them have gastronomic and commercial significance: white truffle of Piemonte truffle (*T. magnatum*), black truffle (*T. Melanosporum*), the summer truffle (*T. aestivum*), winter truffle (*T. brumale*), Chinese truffle (*T. indicum*), whitish truffle (*T. borchii*). The interest in developing the truffle culture is growing rapidly worldwide, given the fact that so far numerous International Congresses on truffle science and culture took place in Italy, France, Spain. Their theme was the review of scientific research about truffle in the last 20 years on the chemical composition of flavorings, truffle physiology, mycorrhization and control of artificially mycorrhized plants, desert truffles, conservation and not least the fraud. Many fortunes have been paid for such delicacies. Thus, a white truffle (*Tuber magnatum*) of 1.3 kg, found in Croatia in 1999 was sold for \$ 212,000, an event presented in the Guinness World Records book. The record did not last long. However, in November 2007, a giant white

truffle of 1.5 kg was found in the forest of Palaia, close to Pisa, by the Italian truffle hunter and trader Cristiano Savini, who together with his dog Rocco entered into the book of records, being regarded as the world's largest truffle.



Fig. 1. Record –white truffle of 1.5 kg from 2007(www.telegraph.co.uk)

It is an increasingly fierce race, as the pollution and deforestations make truffles hard to find. There are types of truffle with a very low selling price, such as Chinese truffle (*Tuber indicum*) and species such as black truffle (*Tuber melanosporum*) where the selling price is forty times higher.

MATERIAL AND METHOD

Growing real truffle is possible only by creating a *home* for them, ie truffle genus plants. These are plants whose roots are specially designed to pair with truffles with which they live in symbiosis. Truffles live in symbiosis with many plant species, most of them forest trees, which are found naturally in forests or they are grown in systematic cultures for the truffle production - oak (*Quercus pubescens*), hazel (*Corylus avellana*), *Quercus sessiliflora*, *Quercus pedunculata*, *Quercus ilex*, *Quercus coccifera*, *Carpinus Betulus*, *Fagus sylvatica*, *Betula pendula*, *Populus alba*, *Populus nigra*, *Tilia sylvestris*, *Olea europea* - *Salix viminalis*, *Juniperus communis*, etc. (A. Chatm La Truffe 1869). Therefore, for positive results in setting up a truffle plantation, we must consider first of all the plant species that succeed in the culture area, truffle species that can live in symbiosis with the roots of these plants and not least the soil properties where they are formed and developed. Truffles belong to the superior fungi (Macromycetes) and they are systematically part of the class Ascomycetes, that is fungi which form their reproductive organs, spores in small bags called "asci". Asci can be found in fructifications, ascospores, which vary in shape and size. Truffles belong to Pezizales class and Tuberaceae family of the ascomycetes, forming a closed ascocarp (the edible part of the truffle) into the ground.

The underground fungus belongs to the genus Tuber, which includes several species of fungi, some with high alimentary value (of those mentioned above) and others with small value or inedible (with unpleasant, repulsive odour - *Tuber rufum* or with radish or mustard odour - *Tuber rapaeodorum*). Generally, a truffle has a

globular form, ovoid tuber shape, covered with a wrapper - epidermis under which the inner "pulp" is located. The epidermis may or may not be smooth, made up of sides, angles or pyramidal projections, more or less obvious, with colors that vary by stage of development but also by the significant ascospores of different species (from white to yellow to white truffle - *T. magnatum*, brown, reddish brown, from brown to black to black truffle - *T. melanosporum*). All species have tufts of short or detailed hyphae, with spiny differentiated hyphae, features very useful for species recognition. The pulp is meaty, full, soft consistency, hard or resistant, it varies upon the degree of maturation and it is specific to this species, factor useful for their recognition too. Also, the color is specific to each species and it varies depending on its maturity. The best known truffle species that grow spontaneously in nature or are obtained by establishing systematic cultures are:

Black truffle (*Tuber melanosporum*) (Fig. 2. a) is the jewel of French cuisine, also called Perigord Truffle (region of southern France, where it grows exclusively on oak tree), the most attractive of the French truffles, with a high demand by consumers and gastronomists due to its qualities. It may be categorized "extra" in local markets because of these properties, according to commercial Law on fresh truffle.



Fig. 2. a) Black truffle (*Tuber melanosporum*) (manitariazagora.blogspot.com)
b) White truffle (*Tuber magnatum pico*) (manitariazagora.blogspot.com)

White truffle (*Tuber magnatum pico*) (Fig. 2. b) or the truffle of Piemonte (Italy) because it fructifies abundantly in this region. It is also encountered in other areas of Italy and southern France on smaller surfaces. Its flavour is very nice, but different from the flavor of the other truffle species, representing a true culinary delight, is extremely popular and sought-after in the great restaurants of the world. Its specific characteristic is that in the place where it lives rarely develop other species of truffles. *Tuber magnatum* is a very rare species, but due to its special quality characteristics, there is high demand by consumers and a high sale price (much higher than for the black truffle), as much as 2000-3000 Euros per kilogram. The white truffle has a spherical shape, with many "cracks" that gives it an irregular shape. It has a smooth and slightly velvety surface. The color varies from pale white to a dark beige and light green. The pulp is unique by its white or yellow color, with thin white veins.

Whitish truffle (*Tuber borchii* or *T. albinum pico*) (Fig. 3. a) These fungi are popular in cooking because of their nice smell and taste, strong at the beginning of maturation, but that quickly deteriorates, with an unpleasant odour of garlic.



Fig. 3. a) Whitish truffle (*Tuber borchii* or *T. alinum pico*) (www.trufamania.com)
 b) The Summer truffle (*Tuber aestivum*) (ayme-truffe.com)

The Summer truffle (*Tuber aestivum*) (Fig. 3. b). The summer truffle is currently the most popular truffle of Europe. Cultivation areas are many and various, we find it in all places where we find the black truffle and not only, but also further north (Germany, former Soviet Union) and further south (Morocco). This truffle culture was abandoned by many farmers in France, because its selling price is much lower than the black truffle price. They taste and smell quite pleasant.

RESULTS AND DISCUSSION

The cost of setting up a truffle plantation on an area of 1 ha includes the cost of the groundwork for the establishment of a tree culture (soil analysis, cleaning and land preparation, applying fertilizers, planting and etc.), plus costs for irrigation, for fencing and the purchase price of mycorrhized seedlings in nurseries certified coming from abroad. Thus the total cost of establishing a culture on one hectare of land was estimated to reach around 17,000 Euros. DURATION OF CULTURE ie production period depends on tree species and size, planting distance, soil quality and cultivation methods. Culture of truffles on hazel tree maintains in full development for 25-30 years, on the oak tree is usually maintained for 30 years and it can reach up to 50 years if the appropriate cutting down process is applied. First fungi appear after 4-6 years as for the hazel trees and for the other species after 7-8 years or even after 10 years (oak). For a truffle plantation to be profitable, 70-100 kg of truffles per hectare / year must be harvested after waiting for 10 to 12 years. It is said that 200-300 kg / ha have been harvested and even more from the 15th year of culture.

The experimental field is located in northern part of Xiromero region from Greece, city Katuna. Before setting up the truffle plantation, the land was chosen according to the pedo-climatic needs of culture. The soil analysis results, but also the climate information gave us the opportunity to choose the plant species and truffles which are suitable in our area. After a preliminary soil fencing and preparation, in the autumn of 2006 inoculated seedlings with truffle spores were planted on an area of 0.5 ha of land. Prevailing views of European scientists involved in the research on truffle development is that every country should use native species of trees, infected with the traditional truffle species existing in nature, for the desired results. **Raggi-vivai** Company from Italy recommended first of all

the oak tree *Quercus pubescens*, then the hazel tree and the linden tree for our area. Certified seedlings were ordered and purchased from this company through intermediaries in the autumn of 2005. It is generally recommended to choose mycorrhized plants of one or at most two year-old for having the highest percentage of success.

There were planted inoculated oak trees with spores of the white truffle (*Tuber magnatum*) and the winter black truffle (*Tuber melanosporum*), inoculated hazel trees with spores of the black truffle (*Tuber melanosporum*) and the linden trees with spores of the summer truffle (*Tuber aestivum*) in the experimental field of culture. Simultaneously, using the same species of inoculated plants, we established another control culture on an area of 0.25 ha of land, in order to make a comparison between both plant and truffle growth and development from the two lands. Experimental field planting was done at distances of 6m x 3m for the oak, hazel and linden trees, with a total no. of 250 plants to 0.5 ha, and the blank land planting was achieved at greater distances, 5m x 5m for hazel and linden trees and a distance of 6m x 5m for the oak trees, with a total no. of 90 plants to 0.25 hectares. Maintenance works over the years were different in the two fields of culture, especially in terms of irrigation and cutting trees. Both cutting and the required systematic irrigation processes have been made in the experimental field, as compared to the blank land where the cutting process was not executed and the systematic irrigation process was minimal, almost natural conditions. Development of trees in those two truffle plantations is different; the conditions of maintenance and care especially influenced the increase in their height.

The most important role so far is the water, which influences the growth and development of inoculated plants. All three species of trees have grown well in the experimental field (without any loss of seedlings), under normal irrigation conditions, compared to the blank culture.

In case of the blank culture, where irrigation has been very limited, much closer to natural conditions in the area, tree growth was slower, and gradually during the first four years of cultivation, due to water scarcity during the summer, led to a total elimination of the culture of the linden trees and 20% of the hazel trees. It seems that these two species, especially the linden, can succeed in our area only in optimal conditions of irrigation (Fig.4).



Fig. 4. Images from the experimental field (hazel and oak) in the optimal conditions of irrigation and maintenance. truffle hunting with dogs specially trained (original year 2011)

Since the summer of 2010 until now 3-4 attempts of searching for truffles with rented dogs specially trained for this truffle hunting (Fig. 4), particularly for hazel trees that bear fruit sooner than the other species of plants. So far the results are not quite as expected, but still hope that we will eventually discover the long-awaited truffle.

CONCLUSIONS

- The most suitable species would be the black truffle species (*Tuber melanosporum*) and especially the summer truffle (*Tuber aestivum*) of the truffle species known in Xiromero region from Greece, which were identified in the vicinity under natural conditions.

- The plantation of mycorrhized trees, hazel, oak and linden species is 5-6 year-old and it develops normally and in terms of evolution there are all prerequisites to meet the conditions for fructifying the truffles very soon.

- The soil of the truffle plantation corresponds in terms of orography, the physical and chemical traits. Values determined by tests fall within the parameters known to favor the normal development of truffles.

It can be said that all trees will produce truffles and how many years do they need to begin to produce, since this process is closely linked to both environmental conditions and confirmation of the existence, presence of the same type of truffle, wild shaped in that region.

Unfortunately, these are not yet well known in Greece and new cultures have a high rate of uncertainty. So we anticipate a certain production of truffles, but the percentage of is not known. "What is a truffle? It is a magic of nature, ecology over centuries, it is the life expression of unpolluted soil."

REFERENCES

1. Sficas G.. (1998). Trees and shrubs in Greece - 1998.
2. Diamandis S.: The cultivation of truffles ; -Thiras Greece-2003
3. Gatsios Kassandra, 2007, The truffle and its cultivation (Η xpoucpa Kai ρj KaMaspyeia xpc;). Agro Tipos Publishing House (Aypo Tβ7io;- 2007) Athens.
4. Coli R., Coli A.M., Granetti B., Damiani P.:Composizione chimica e valore nutritivo del tartufo nero
5. Blanc J.P.: Tables alimentaires
6. Bardet M.C: Truffe. Les contitions de culture. Infos – Ctilf.-1995
7. Regione Marche -Centro Sperimentale di Tartoficoltura -www. Agri.marche.it
8. Mnozzi L.: Il tartufo e la sua coltivazione. Ed.Edagricole -Bologna 1991
9. Syndicat des trufficulteurs du Haut Rhone: La plantation d' arbres truffiers
10. Pepiniere Wollner - Culture et vente de plants truffiers - Tehniques de culture
11. Mico Plants-Tartuficoltura -Principali-specie-di-tartufo(articoli) - www.micoplants.com