

INTRODUCTION IN TRUFFICULTURE IN XIROMERO AREA, GREECE

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Abstract. *Xiromero region, from Greece, is an area having a quite low agricultural potential because of relatively dry weather conditions during summer and the widespread of the rocky soil. Since, in general the truffle (the underground fungus within the genus Tuber), grow on arid lands, mountains or difficult areas (they can successfully replace others crops, cultured plants which has no productivity in these areas), it have been done experimental cultivations of such truffle in this Greek region. In setting up of the trufficulture in Xeromero it had taken into account the experiences of countries with tradition in this field – Italy and also France and Spain, mainly it were sought data on climatic and geology structure needed for truffle to grow and develop. Five cultivated areas were tested in order to determine the main parameters: pH (7-7.8), CaCO₃ (%), Humus (%), total nitrogen (%), phosphorus (%), C/N ratio, etc. Moreover, the prevailing climatic conditions of the area (temperature, humidity, rainfalls, etc.) and studies of the Agrinio weather stations data during the last twenty years, are within the necessary range for cultivate such of truffle crops. A detailed study has been carried out in wild truffle, uncultivated crops, illustrative in different kinds of forests. With the purpose of the possibility of agricultural operations with truffle it were gathered a lot of available information and indicators.*

Keywords: trufficulture in Xiromero, Greece, geopedology and climatic aspects, symbiosis plant-mushroom.

INTRODUCTION



Fig. 1. Xiromero region

Truffle, one of the rarest and most required mushroom species, grow in underground and live in symbiosis with roots of specific trees or bushes and also, involve edafoclimatic specific conditions. Truffles are edible mushroom with exceptional taste and aroma. The fame of these gifts of nature is due primarily to their higher nutritive value, and of course, doubled by their wonderful intense flavor and taste. If caviar are placed on the top of the animal products, than is certainty that truffles are the best among the vegetal food. It is not reliable to speak about

“truffles”, in general, because there is a great variability of species, and not all of them have a high quality and neither the same commercial value. From many existing species (more than 50), only 7-8 have an economical and nutritional importance. As significant food it can be mentioned the following species of truffles: white truffle (*Tuber magnatum*), black truffle or "black Périgord truffle" (*Tuber melanosporum*) and summer truffle (*Tuber aestivum*) (Fig. 2).



Fig. 2. Species of truffles

These underground fruits have been known and appreciated since antiquity. They were some of the tastiest and most precious nourishment of the pharaohs, and later on of the Greeks and Romans. Truffles were harvested in the past only in forests where they were growing naturally in the wild. In the last twenty years, due to the higher and higher consumers' demand, and others natural causes, the number of the wild truffles has considerable decreased, nearly to depletion, in present days is very difficult to harvest spontaneous truffles in their natural environment. And until recently, it was thought to be quite impossible to cultivate them outside of their native habitat.



Tuber melanosporum,

Truffle-producing plants in a green house

<http://www.proverde.it/Tartuficoltura.htm> Piante di Nocciolo in serra micorrizate con *Tuber melanosporum* (vivaio UmbraFlor s.r.l. "Il Castellaccio" - Spello PG)

Fig. 1.3. Truffle producing in a green house

Therefore, in recent decades, it has been carried out numerous researches and investigations in order to understand the reproduction and the conditions needed for this mushrooms to growth and development, in brief: to find out the truffles farming potential and to obtain **artificial truffles** crops (Fig. 3). As expected, in the end, the desired result has been got, so during 1960-1980 the truffles were cultivated in laboratory on mycorrhizae plants, and than were developed in green houses. Within this time period, after trials and studies that had been made on mycorrhizae roots (tubers and others mushrooms) it was obtained the first symbiosis between steril ectomycorrhiza plant and truffle (Fassi and Fontana -1967, Fontana and Palenzona -1969, Fontana and Fasolo -1971).

This led to the confirmation that the birth and growth of truffles is not exclusively in the hands nature, but now is driven by human, how are able to farm this kind of mushrooms. There were established truffle plantations and it is possible to speak about a “conducted truffle”, but 100% natural and nowise artificial (Dr. Gabriella Di Massiamo 2008 –Spotelo).

Indeed, research and experiments were directed mainly to the growing of the precious black truffles (*Tuber melanosporum*) that grows exclusively with oak and whose biology and ecology much more known by comparison with the white truffle (*Tuber magnatum*) which has a more complex biology and is more demanding as regard the environmental factories.

The market demands for this “gastronomic bouquet” are constantly increasing, however the supply is much below to the consumers needs, and that is the reasons for the exorbitant prices, especially the white truffle (*Tuber magnatum*) are sold for about €3000 per 1 kilo, and black truffles (*Tuber melanosporum*) sold between €900 and €1600 per kilo.

The ecological studies of the abundance of spontaneous truffles throughout its territory led to the understanding of the main factors responsible for their good development. As examples of these important growth factors that have to be taken into consideration we can notified the following: the nature of soil, climate, exposition, vegetation and the wood species which the truffles are living on in symbiosis. The cultivation of truffles is a highly efficient agricultural activity and not requires a lot of manual work, a pure biological culture.

The whole biological cycle of truffle are occurred in the soil from where they procure and accumulate nourishments and also where truffles find favorable conditions for growth and development. Each species of truffle is depending on the annual and seasonal tendency of micro-environmental conditions, particularly the pedo-climatic conditions. The truffle needs a favorable vegetative perimeter, because the forest and herbaceous species have a key role in the synthesis of mycorrhizal symbiosis. The truffle live in symbiosis with many plant species, most forest shrubs. The main plant species whose roots are symbiotic with truffle mycelium and can be found in forest or are farmed systematic-cultures for the truffle production are: oak (*Quercus pubescens*), hazelnut tree (*Corylus avellana*), Kermes oak (*Quercus coccifera*), hornbeam (*Carpinus Betulus*), beech (*Fagus sylvatica*), white poplar (*Populus alba*), black poplar (*Populus nigra*), lime (*Tilia sylvestris*)

etc. These mushrooms are good for any purpose, they fill the environment with that suave and unconfused aroma. Even if it is very appreciated, known and studied for a long time, its cultivation has still got many undetermined items and requests a lot of patience from the persons willing to farm it.

MATERIAL AND METHOD

In order to establish a new truffle culture in the Xiromera area, you need researches pertaining to soil and climate of the area in comparison with the regions from countries with tradition in truffle cultivation, as Italy and France.

We can not speak in generally about a specific soil favorable in growing truffle, because each species needs particular physical and chemical features. As regards the soil, the truffles do not grow of any kind soil; they required an aired and soft soil containing many nutritive substances, soil reach in calcareous, Carbon/Nitrogen proportion has to be around 10.

In general, the black truffle prefers poor soil, alkaline with a pH from 7.7 to 8.4, it is considered that soft, sandy loam-calcareous soil and middle loam-calcareous are the best for them. White truffle prefers valleys with fertile soil, having a pH from 7.4 to 8.1, with an average pH of 7.7.

The experience field is situated in the northern Xiromero at an altitude of 350 meters, in Katuana.

Before establishing the trufficulture testing the soil was a necessity on at least two levels deep, at 15-30 and 30-50 centimeters. The soil analyses were made outside the experience field, on others four experience fields within the same area. These were sent and analyzed in Larisa city at the Regional Laboratory of agriculture appliance and analyses of fertilizers. From the soils samples for both physical and chemical tests but from the observations made upon the fauna from that specific area they gave us the possibility to orientate towards the species that can be grown not only on our testing field but on the other already analyzed in this end.

The making of the new experimental field was done in autumn using three different kinds of seedling plants (hazelnut tree, oak and lime) which were inoculated with spores of truffles (white truffle, black truffle and summer truffle).

RESULTS AND DISCUSSION

By making a comparison between the results obtained at the soil analyses from our experience field with the recommended physical and chemical features (from, Cultivo de trufa negra J.A. Bonet, D. Oliach & C. Colinas) of a suitable soil for the optimal growth of these mushrooms, observations made upon this in Table 1.

Due to the tests results on the soil sampled from our experience field we came up with the conclusion that it is argillaceous and it has a suitable pH. But, the most important problem is our low percentage of calcium carbonate, which is a key factor in the obtaining a truffle culture.

The soil is also adequate as regards the pH (7.1-7.9) but also regarding the structure, texture and the content in some of the main nutrients.

Beside the soil trials the climatic conditions are also extremely important for the forming of the truffles plantation, but the optimal development and growth of the plants and truffles too. In general, the climate in this area is specific to the Mediterranean area, meaning soft and moist winters and dry and long summer.

Table 1

Observations obtained at the soil analyses

| A/A | Parameters | Recommended physical and chemical features | Outcomes |
|-----|------------------------------|---|-------------------|
| 1 | pH | 7 – 8.5 | 7.77% |
| 2 | Organic substances | 1.5 – 8% | 1.30% |
| 3 | Total calcium % | 1 – 70% (ideal 20 – 50%) | 4150 mg/l |
| 4 | Phosphorus % | Total P: 0.1 – 0.3% Assimilable P: 12 – 18 ppm | P Olsen (mg/kg) 5 |
| 5 | Potassium (K ₂ O) | 0.01 – 0.03% | K+ (mg/kg) 154 |
| 6 | Assimilable Magnesium % | 0.01 – 0.013% | Mg+ (mg/kg) |
| 7 | Carbon/Nitrogen proportion | 5 – 20%; Ideal | 6% |
| 8 | CaCO ₃ % | 0.5 – 80%; Ideal: 35% | traces |
| 9 | Sand % | 20 – 80% | 19% |
| 10 | Clay | 5 – 50 % in relation with the truffle specie | 60% |
| 11 | Loam | 5 – 80% | 21% |

The climates parameters within 2003-2008 were obtained from the closest weather station which can be found at the former Agrinio airport and within 1976-2002 climatic data were obtained from the tobacco development center; as follow:

Table 2

The climates parameters within 2003-2008

| Year | The average annual temperature | Total annual rainfalls (mm) | The sunshine period (hours) | The average relative air humidity (%) |
|-------------|--------------------------------|-----------------------------|-----------------------------|---------------------------------------|
| 1976 – 1980 | 17.27 | 981.33 | | 58.68 |
| 1991 | 17.2 | 954.2 | 1905h, 33min | 63.9 |
| 1995 | 16.4 | 865.5 | 2667h, 1min | 71.1 |
| 1999 | 18.2 | 954.2 | 2635h, 8min | 71.3 |
| 2003 | 17.8 | 865.5 | 2548h | |
| 2006 | 17.1 | 823.2 | 2693h | |
| 2008 | 18 | 588.9 | 2370h | |

Regarding the specific climatic condition and the soil structure it is assumed that Greece is suitable for the summer truffle (*Tuber aestivum*) not only on the forest plants but on the olive tree too (until now realized only experimental).

As for the vegetative outlining in Xiromero (an other important aspect in the set up and the development of truffle in those cultures), it can be said that it is formed mostly out of the oaks forests (*Quercus ithaburensis – macrolepis*, one of the most important species of the Greek's flora), downy oaks forests (*Quercus pubescent*), kermes oaks forest (*Quercus coccifera*), and then the level of semi-bushes, shrubs, grassy plants and mosses. The experimental field is also surrounded by *Quercus coccifera*, which indicate the fact that the vegetative outlining is ideal for the growth of both trees and truffles.

Lately Bulgaria and Romania have presented some interest in trufficulture, due to the existence of the wild truffles in the spontaneous flora of these countries, is obvious the there are suitable condition that enhance the growth of there mushroom. All there trials benefit from the government support. The officials think that replacement of the indigene crops with truffles may be a solution.

CONCLUSIONS

Are regards the soil and climate conditions and also the trees species from the natural environment, we would have:

1. the average annual temperature in Xiromero (16 – 18.7⁰C) is getting close to the average annual temperature from other regions, as Italy and France (15 – 16⁰C) where truffle has been successfully grown;
2. the amount of rainfalls into the researched area (700 – 900 mm) is within the limits for truffle growing (500 – 1400 mm), being also closed to the truffle cultivating regions from Italy (600 – 800 mm), and France (700 – 800 mm);
3. the 350 meters altitude where the testing field is situated is within the limits of truffle cultivation (150 – 400 m);
4. the forestry species with whom the truffles are in symbiosis *Quercus ithaburensis – macrolepis*, *Quercus coccifera*, *Quercus pubescent* are growing spontaneously in this specific area and crate optimal condition for the association with truffles;
5. the soil is adequate in terms of pH level (7.1 – 7.9) but also regarding the structure, texture and the content in some of the main nutrients.

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