



Evaluation Of The Potential Of Growing
Tuber Uncinatum
As A New Model For Future
Agricultural Investments
In Rural Areas Of Romania

A study by

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PART ONE

Cultivation Analysis and Practical Consideration

1. Summary

It is concluded that the establishment of a Burgundy black truffle plantation later on, an overall industry is possible on several areas of Romania. The key points of this study include:

- The edaphic (soil) and climatic requirements of *Tuber uncinatum* can be met in several locations in Transylvania especially where natural rainfall can be supplemented by irrigation. In the Banat region the cultivation of other species like *Tuber melanosporum* could be also considered.
- Concluding the scientific work of the well-know Transylvanian mycologists Misky Mihály, Pap Géza, Pázmány Dénes, Negrean Gavril we believe that the widespread presence of this fungus in several areas of Transylvania, can and will contribute to a more prosperous economical growth of the region, if we are able to organize its sustainable collection and cultivation.
- The hypothesis is that cultivation of *Tuber uncinatum* is possible on areas where *Tuber aestivum* (syn. *Tuber uncinatum*) is growing indigenously.
- Unlike the highest priced truffle, the *Tuber melanosporum*, which requires Mediterranean weather conditions and high level of humidity (generally found between latitudes 40-47° north), the more modest *Tuber uncinatum* prefers a shady site, on higher altitude, which makes it our choice for cultivation.
- There is a good opportunity to establish truffle plantations based on the technologies and inoculated plants developed in the Western-European countries.
- The truffle industry could be a new way of future agricultural investments in Romania alternating the non-competitive products. Several farmers as well as businessman interviewed in locations identified suitable for growing truffles, expressed major interest in participating in this fledging industry.
- There is a demonstrated international interest in the participation of the Eastern-European countries in this industry. As a good example, Bulgaria has already made its first steps on the field.
- After successful cultivation of the *Tuber uncinatum* the cultivation of higher priced truffles such us *Tuber melanosporum* can be also considered.
- There is an almost unlimited market potential for fresh Romanian truffles as a replacement for the expensive truffles in Italy and France.
- There are endless possibilities to expand this industry. Truffle sauces, truffle oil etc. are just few of the products that can be prepared in special inland facilities and sold at international markets.
- The cultivation methods are in concordance with the current techniques and regulations of the European Union based on the principles of eco-farming.
- The plantations of the Truffoir Ltd. could stand as an experimental place for private and public universities who intend to develop scientific researches in this field.
- By international standards the future industry in Romania will be comparatively small and confined to reasonably distinct localities. Further, it is expected that there will be a large number of small growers with up to five hectares rather than a small number with large holdings. On the long term because of mutual beneficiary the growers can coordinate their activities and marketing through a growers association as is done in Spain, France or Italy.
- After setting up a producing industry special laws and enforcement will be necessary concerning truffle cultivation, collection and marketing.

2. Introduction

Truffles are edible mushrooms that fascinated people for thousands of years. Their attraction is the tantalizing taste and aroma, which once experienced, can never be forgotten. Magical powers and virtues have even been attributed to them, and it was collected since the ancient times. Growing underground, they are difficult to find and very expensive as a result. The high price – retail prices can top \$7.000 per kg for several species – paid for this fungus is a testimony of its qualities and its diminishing availability. Of the many species of truffle found around the world here we present the most known ones, ranking them after their culinary value:

Commercially important truffle species

Common name	Scientific name	Hungarian name	Culinary quality	Market value
Périgord black truffle	<i>Tuber melanosporum</i>	Périgordi szarvasgomba	*****	****
Italian white truffle	<i>Tuber magnatum</i>	Piroshúsú szarvasgomba	*****	*****
Winter truffle	<i>Tuber brumale</i>	Téli szarvasgomba	****	***
Summer truffle	<i>Tuber aestivum</i>	Nyári szarvasgomba	****	***
Burgundy truffle	<i>Tuber uncinatum</i>	Burgundiai szarvasgomba	***	***
Red truffle	<i>Tuber rufum</i>	Rőt szarvasgomba	**	*
Hollow truffle	<i>Tuber excavatum</i>	Üreges szarvasgomba	**	*
Macrosporum truffle	<i>Tuber macrosporum</i>	Nagyspórás szarvasgomba	**	**
Mesenterique truffle	<i>Tuber mesentericum</i>	Bitumenes szarvasgomba	**	**
Indian truffle	<i>Tuber indicum</i>	Indiai szarvasgomba	*	*
Chinese truffle	<i>Tuber sinense</i>	Kínai szarvasgomba	*	*
Desert truffles	<i>Terfezia spp.</i>	Homoki szarvasgombák	**	**
White truffle	<i>Choiromyces meandrif.</i>	Fehér szarvasgomba	***	**

Table 1 - Where * indicates low quality or price, ***** high quality or price.

The highest priced *Tuber melanosporum* through the course of time has developed a mystique and value to a point where it is referred to as “black diamond”. Similar but lower quality species like *Tuber aestivum*, *Tuber brumale* and *Tuber uncinatum* are trying with success to earn their place in the kitchen as well. Truffles are principally harvested from the roots of oak and hazel trees using pigs or special trained dogs to locate the position of the fruiting bodies, which lie between 10–30 cm below the soil surface.

The consumption of truffles as a gourmet product has expanded around the world in line with the European colonization. Truffles are sought after as fresh, preserved and value-added products (e.g. oils, pastes and pastas) and typically, because of its high cost, they are shaved into foods rather than eaten whole.

The cultivation and commercialization of several truffle species (*T. melanosporum*, *T. uncinatum*) has been achieved in a limited number of countries in Southern- and Western Europe. To this date there has been no serious attempt to grow and commercialize truffles in Romania, although the climatic factors and indigenous appearance of this fungus are at high values.

This project has investigated the feasibility of establishing a truffle plantation (later a possible industry) in Romania from a practical and economical viewpoint, and has concluded that is a viable proposition and worthy for further serious attention.

3. Trufficulture

3.1 Growing requirements

3.1.1 Host trees

Establishing the relationship between *Tuber uncinatum* and its host tree is the first obstacle that has to overcome in setting up a truffière and it is the key to successful truffle production. It is of paramount importance to understand the symbiotic association between the fungus and the tree. The association called an ectomycorrhiza literally involves the envelopment of the tree roots by the fungus like a many-fingered glove, and where *Tuber uncinatum* in return for mineral ions, particularly phosphorus, receives carbohydrates from the host tree. This relationship has to be nurtured and if this association is incomplete or disturbed the production of truffles suffers. *Tuber uncinatum* will form mycorrhizal associations with a range of host trees:

Tree species known to support mycorrhizal associations with *T. uncinatum*

Common name	Scientific name	Hungarian name
White oak*	<i>Quercus pubescens</i>	Molyhos tölgy
Black oak	<i>Q. sessiliflora</i>	Kocsánytalan tölgy
Holly oak*	<i>Q. ilex</i>	Magyaltölgy
Pedunculate oak	<i>Q. robur</i>	Kocsányos tölgy
Hazel*	<i>Corylus avellana</i>	Mogyoró
Turkish hazel	<i>Corylus colurna</i>	Törökmogyoró
Lime tree	<i>Tilia plathyphyllos</i>	Nagylevelű hárs
Yoke elm	<i>Carpinus betulus</i>	Gyertyán
Atlas cedar	<i>Cedrus atlantica</i>	Atlasz cédrus
Poplar	<i>Populus sp.</i>	Nyárfa
Chestnut	<i>Castanea</i>	Gesztenye
Pine tree	<i>Pinus spp.</i>	Fenyőfélék
Willows	<i>Salix spp.</i>	Fűzfafélék

* Indicates species often involved in commercial production

The different growing requirements stress on to select easily adaptable host species to local growing conditions, but fortunately most of these tree species are indigenous in Romania, which eases the selection process. There are several other fungi, including other truffle species, which will form an ectomycorrhizal association with these host tree species and because *T. uncinatum* is not highly competitive the dominant mycorrhizal fungus may displace it. Therefore at establishment *T. uncinatum* must be given an advantage over other fungal species.

The advantage comes from inoculating the seedlings of the host plant in controlled sterile conditions; choosing a site with ideal climatic and edaphic conditions; planting the trees in soil free from other species of mycorrhizal fungi; and, finally, managing the truffière to optimize the growth conditions for the *T. uncinatum*.

3.1.2 Natural Forests and Plantations

Traditionally truffles have been harvested from natural forests in France, Italy, Spain, Portugal, Yugoslavia, Bulgaria, Croatia and Hungary.

Major truffle growing regions in Europe (Plantations mostly with *Tuber melanosporum*)

France: Quercy, Périgord, Tarn, Languedoc, Provence, Rhône Valley

Italy: Piemonte, Liguria, Venetia, Trentino, Emilia, Marches, Tuscany, Umbria

Spain: Guadalajara, Zaragoza, Soria, Vitoria, Cuenca, Utiel, Gerona, Barcelona, Lerida, Tarragona, Castellon, Valencia, Logrono, Navarra

Attempts to control or manage the growing of truffles began in early last century in Europe when acorns or seedlings collected from under truffle bearing trees were planted out in new areas. However it was not until '70s that host trees were reliably inoculated in containers for subsequent planting out.

Since then, many hectares of truffle plantations or truffières have been established in new areas and in traditional growing regions where forests have been eliminated. The development of inoculation techniques and the rationalization of truffle management has enabled the setting up of huge truffières, e.g. the largest truffière in the world of 580 ha in Spain where natural forest has been supplemented by artificially inoculated trees. The majority of the world's truffles are harvested from forest trees naturally infected with this ectomycorrhizal fungus. Natural truffières are now supplemented by laboratory or glass-house inoculated plants. The inoculation technique developed by Institut National de Recherche Agricole (INRA) in France in the 1970s removed many of the chance factors involved in earlier methods, such as transplanting oak seedlings that had germinated in soil surrounding trees known to host truffle production.

Agri-Truffe, a French company with facilities at St. Maixant, has the sole license for the INRA technology and are currently producing and distributing approximately 150,000 trees per year. These trees are infected with *T. melanosporum*, *T. magnatum* and *T. uncinatum*. The largest part of these inoculated seedlings are used in France, Spain and Italy, but lately Bulgaria, New Zealand and Tasmania has entered the string.

3.1.3 Soil

The soil required for successful fructification of *T. uncinatum* is somehow specific. Ideally the soil should be well-aerated, sufficiently calcareous with a humus level up to 8 % in the top-soil. The pH value of the soil is one of the most important conditions for viable cultivation of truffles. Ideally, the natural pH value of the soil should range between 7.0 and 8.5 (optimal: 7.9). For a pH value below 4.5, truffle production will be inhibited because of aluminium toxicity. If the deviations are small, it is possible to regulate the pH value by liming.

Regarding the mineral and nutrient content of the soil (macro elements: N, P, K, Mg; microelements: B, Cu, Mn, Zn; C/N ratio), the most favorable mineral composition for truffle production varies from soil to soil, since it depends on many different factors, such as soil type, soil structure and content of organic matter. Accordingly, it is not possible to specify generally valid conditions. Before establishing a truffle plantation, it is absolutely necessary that the soil in question be analyzed and evaluated for its suitability. Both the topsoil (15 - 30 cm) as well as the subsoil (30 - 60 cm) should be examined because they are very vital for the relationship between fungus and host (topsoil) and general root activity (subsoil). Soils with a high heavy-metal content are unsuitable for growing truffles, because the development of fruit bodies (i.e. truffle formation) will be delayed or even inhibited.

A truffle plantation should be carefully established on areas that have been used intensively for normal agriculture, since these soils usually exhibit a high level of nutrients and frequently also pesticide residues.

3.1.4. Climate

The cultivation of *T. uncinatum* is possible in a broad range of weather conditions, but oceanic, semi-continental, continental climates are the most suitable. Tuber *uncinatum* was cultivated as far as the Belgian and German borders, however the risk of fruiting bodies freezing in winter is high at this latitude.

Tuber *uncinatum* does not tolerate the soil drying out in the sunshine and, consequently, the plantations must have a high plant density with 800 to 1200 plants per hectare so that the canopy rapidly shades the soil. Tree pruning must be minimized for the same reasons. It is advisable to mix trees that produce quickly such as hazels with those that continue fruiting for much longer, for example, sessile oaks. The conditions for cultivating *T. uncinatum* are quite compatible with those for reforestation. Therefore it is also possible to reconcile truffle cultivation with forestry unless the soils are highly contaminated by pesticides or competing ectomycorrhizal fungi.

Essentially, Tuber *uncinatum* prefers a climate where the seasons are well defined but not characterized by extremes. High summer temperatures can be endured if the soil has an ideal structure and water is available through rain or irrigation. Heavy frosts and long periods of winter cold (eg. 10 days at -15°C) are harmful to the development of the truffle. The annual rainfall must be well divided between the seasons to facilitate the different stages of development of the fungus. Spring and summer rain is essential for recommencement of mycorrhizal activity and for mycelial growth; autumn rain to assure maturation and moderate rain or snowfall in winter to avoid decomposing of the fruit body in the soil. In the absence of regular or predictable rain, irrigation must be provided to ensure the proper growth of the host trees and the fungus.

Climatic conditions suitable for the growth of *Tuber uncinatum*

Climatic variable	Range
Annual rainfall	350 1500 mm
Mean daily temperature in summer	16.5° 22.5° C
Mean daily temperature in winter	- 10° 8° C

3.1.5 Harvesting

The harvesting of truffles has always been problematic because the fruiting bodies ripens and remains underground. The strong sweet odor, which is able to penetrate the overlying soil, is the most obvious clue to the whereabouts of the truffles. Whilst the human nose may detect the smell in a truffière it does not have the olfactory acuity to pinpoint the location. Consequently, dogs and pigs have been used through the ages as the prime means of detecting and harvesting truffles. Because the truffle odor imitates pig pheromones these animals require little training to search for them, however an adult pig has formidable strength and is difficult to control and transport. Dogs have thus been the preferred animals even though they require more intensive training.

Well-experienced growers can detect truffles by observing the truffle fly *Helomyza tuberivora* emerging from the soil but this method for harvesting is not compatible with a commercial operation. Recent newspaper reports have made reference to an electronic detector, which has been developed in the United Kingdom - whether this apparatus proves to be effective in commercial truffières remains to be seen.

The use of mechanical devices, or even picks and shovels, to harvest the truffles as one might harvest potatoes has long been recognized as being highly destructive to the mycorrhizal association therefore it must be avoided.

3.1.6 Annual cycle

The *Tuber uncinatum* has an annual growth cycle, which culminates in the ripening of the fruiting bodies in autumn and winter. In the Romania the harvesting can commence in September, and continue through to late November. The following table summarizes the life cycle:

The annual cycle of *Tuber uncinatum* in Romania

Month	Stage
January	Spores germinate in the soil and induce mycorrhizas
February	The mycelium spread and colonizes the soil
March	Sexual reproduction takes place
April	The fruiting bodies form
May	The fruiting bodies grow slowly
June	The truffles commence to grow rapidly
July	The truffles continue to grow
August	The truffles commence to mature
September	The truffles ripens
October	The truffles continue to ripen and are harvested
November	Harvesting
December	Truffles left in the ground release spores

3.1.7 Production

Commercial and steady production may be reasonably expected after 10 years. It is recognized that hazel trees come into production faster than oaks (after 4 or 5 years), therefore a mixed plantation is recommended for long-term sustainable cultivation.

Mixed planting offers the benefit that the stronger vegetation of hazels will promote the development of fruit bodies, thereby ensuring earlier and better yields. However, the cultivation of hazelnut saplings involves more work, as the foliage has an acidifying effect on the soil and must therefore be transported out of the field in autumn.

Under ideal conditions harvests of up to 1 kg per tree have been recorded but more typically after 10 years with half the trees in production 30 kg/ha would be considered a good harvest. At peak capacity in a well-managed truffière there is no reason to expect that 30-100 kg/ha would be an unreasonable achievement. If well maintained a truffière can continue to produce for around 100 years.

3.1.8 Inoculating host trees

As indicated in section 3.1.2 there are many trees being inoculated with truffles each year, especially in laboratories in Italy and France. The methodology used is kept in confidence as a commercial secret, but inoculated trees are distributed widely on an average price of 9 Euro / tree.

If considering the truffle cultivation on a larger scale, setting up an inoculation facility will be necessary, but it can be established only with the involvement of the Romanian government.

3.2 Growing requirements for *Tuber uncinatum* in Romania

As indicated in sections 3.1.3 and 3.1.4 the growing requirements for *Tuber uncinatum* are quite specific, but these requirements can be met in a number of locations in Romania. The surrounding areas of Cristuru-Secuiesc (Székelykeresztúr) has been identified as such a territory, where Transylvanian mycologists Misky Mihály, Pap Géza, Pázmány Dénes and Negrean Gavril identified 38 different indigenous underground mushroom species over a period of 30 year. Soil testing results undertaken at several sites in this region has indicated that ideal conditions exist for truffle cultivation.

Soil test results from a site in the region of Cristuru-Secuiesc showing good potential for truffle growing

Test parameter	Optimum	Recorded
pH	>7.5	5.6-7.6

The Truffoir Ltd. is the owner of a 5 ha land in the rural area of Vânători (Héjjasfalva) where preparation for truffle cultivation will be started in spring 2004.

4. Market Profile

4.1 Supply

Earlier this century the annual truffle production in France was estimated to be between 1.000 and 2.000 tonnes. In the last decades the production has crashed some 95% because of habitat destruction, land clearing for urban development and pursuit of other agricultural enterprises. In Italy production was estimated to be approximately 91 tonnes in the 1880.

Total annual production of Tuber melanosporum in France between 1958-1993*

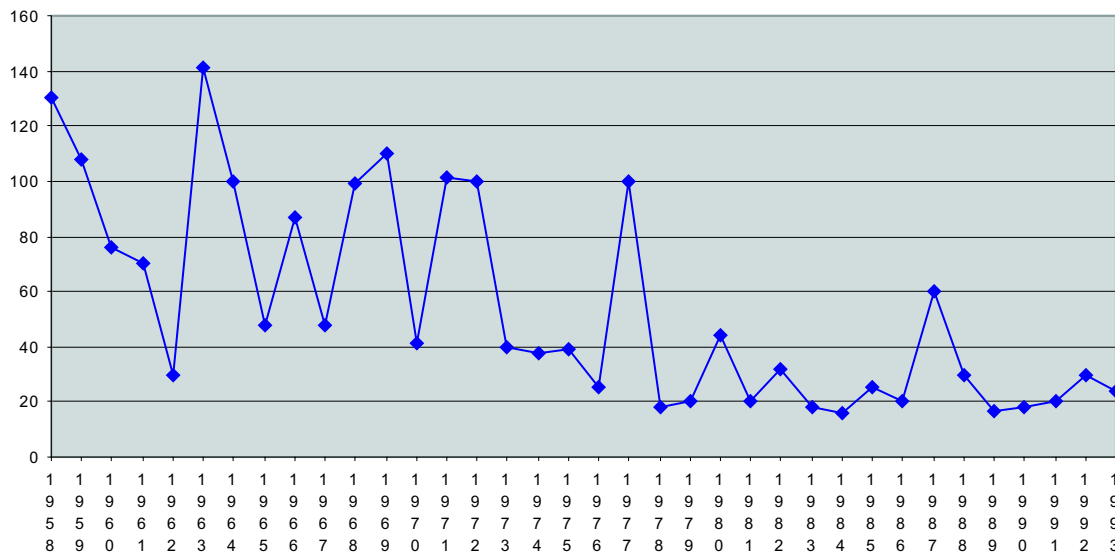


Table 2 - * Data presented by Pierre Sourzat (1994)

As it appears in the chart, seasonal conditions have a significant impact on productions and this is reflected in the widely differing tonnage each year. The general decline in the French industry has been mirrored in the Spanish and Italian industries over the last quarter century and this downward trend has served to increase the shortage and thus maintain prices.

It is very important to mention that any evaluation of the world truffle market is subject to high level of secrecy that masks the true figures. The lack of records and the under-the-table dealings ensures the farmers do not disclose commercially sensitive information on the production of truffles on their farms. The secrecy is a well-entrenched characteristic of the market in all parts of the world.

4.2 Product

4.2.1 Commercially important truffle species

There are several truffle species present on the world markets. The *Tuber magnatum* and the *Tuber melanosporum* are the highest priced truffle, but the trend in the international truffle industry is the increasing substitution of these expensive species, with lesser grade truffles such as *T. brumale*, *T. uncinatum*, *T. indicum* and *T. sinense*, although *Tuber uncinatum* is a well appreciated substitute.

Tuber uncinatum has earned a good reputation in the market, and despite of its lower quality than *T. melanosporum* was able to maintain a retail price of 140-160 Euro/kg. Taking advantage of the inability of the consumer to differentiate between truffle species, some disreputable traders use *T. sinense* (which has a retail price of 3.5 Euro/kg) for its substitution and command the price of *T. uncinatum*. It is believed that a worldwide certification program would help to stop this practice and rebuild confidence amongst consumers.

4.2.2 Fresh *T. uncinatum*

The fruiting bodies of *T. uncinatum* range in appearance from round to knobby and typically weigh from a few grams to several hundred grams and range from 2 cm up to 10 cm in diameter. After consultation with chefs and distributors there is apparently a preference for smaller truffles ranging from 2cm to 5cm with a regular spherical shape. Fresh truffles constitute approximately 40% of the market.

Key things looked for in truffles are aroma, flavour and firm texture with the absence of fungal or bacterial infection and no evidence of insect attack. The aroma and texture are a function of correct harvesting time (with respect to the stage of maturation of the truffle), proper handling and a short elapsed time from harvesting to table is preferred. The market accepts five to seven days delivery time since deterioration and dehydration can be significant after this period of time despite ideal handling and shipping conditions.

There are various forms of packaging depending on the distance to be traveled and the market/client receiving the product. Packaging with a natural feel and appearance and a rustic character is normally highly regarded by both commercial and domestic consumers. The most common means of packaging the fresh product is in straw and plastic baskets and in small wooden boxes filled with rice and vacuum-sealed in plastic. For local delivery they are sometimes repackaged with eggs or cheese, which are then consumed as a value-added product, or they are incorporated in a vacuum-sealed package with meat and left for a period time to permeate into the meat.

Because of the strength of flavour and price they are usually finely sliced or grated into dishes. Only on rare occasions are eaten or presented whole.

Truffles are used in a wide variety of dishes ranging from the most basic omelette or scrambled eggs to the finest dishes. There are strong cultural and traditional customs dictating the types of dishes flavored by truffles, which vary by region.

4.2.3 Preserved truffles

Preserved truffles are used principally out of season when the fresh product is unavailable. Presentation of preserved truffles is either in bottles or small cans depending on the supplier. The most common form of preparation is simply boiling the truffle in a brine solution and hermetically sealing it in glass or tin. Variations in the preparation include cooking the truffle in a mixture of alcohols or in oil. Chefs have different preferences for the various preparation methods and often buy fresh truffle to preserve in their personal secret mixtures/recipes.

Sold and consumed out of season the preserved truffles constitute 60% of the market volume of truffles consumed. Even though an inferior product the preserved truffles command a high price. The demand trend in all markets for truffle produce is growing at such a rate that the supply cannot keep pace with it.

4.2.4 Value-added products

There is an increasing use of truffles as an additive in flavor enhancers, condiments and processed foods such as salsas, terrines and foie gras. Salsas prepared with artichokes, black olives, green olives, almonds, garlic and butter have wide international appeal and are readily available in regular packaging of glass jars, tins and tubes.

Other forms of value-added products are oils, pastas and breads. Truffle oils are primarily used in salads and cooking and are predominantly used by the catering and restaurant industries. Traditionally, in both domestic and commercial situations, truffle value-added products were personally prepared the chef or cook of the house or restaurant. This is still common in major restaurants with pastas and breads.

4.3 Demand

Demand for *T. melanosporum* and other truffles has increased over the latter part of the 20th century because of inconsistent supply and decreased production. All participants in the global truffle industry have all indicated that they expect market demand to continue to increase as truffles are more actively marketed and greater consumer awareness develops. Further, the supply of fresh premium grade truffle is not expected to meet this increasing demand.

The combination of increasing demand and falling production has naturally resulted in high prices being maintained. But it is interesting to note that in years of real scarcity the average price does not necessarily increase. This phenomenon is due to sub-optimal conditions resulting in poorer quality truffles, which do not command premium prices.

The market for Romanian truffles is essentially stratified into levels depending on quality, quantity, rate of production, and reliability of supply. Individual restaurants both in Romania and Hungary will take up small quantities, in the order of kilograms per week. Wholesalers in Europe will buy production of tens of kilograms per week. The major processing and distribution houses of France will buy high production levels in the order of hundreds of kilograms per week, if this amount will be reached.

Weekly production of truffles from Romania and projected market segmentation

Kg/week	Market
0 - 20	Domestic consumption and individual buyers from Hungary and EU
21 - 100	Small production houses and wholesalers in the European Union
100+	Large production houses and distributors in France and the EU

The markets ultimately served would vary with and depend on the production profile through the season, but being aware of the high international demand, all truffles produced in Romania would have a market.

4.4 Distribution

Traditionally, growers going to key regional markets in France initiated the distribution of truffles. At these markets, agents, wholesalers/distributors and gourmets would buy directly from the vendors transacting the deal with handwritten offers and cash. The produce was presented in baskets, handling of the truffles was not permitted and the purchaser had to rely solely on smell and appearance. The old markets in France, Spain and Italy are still run in much the same way but there has been a move to individual supply contracts being negotiated with preferred growers.

Elsewhere in the world where traditional markets devoted to truffles do not exist, imported truffles or the small quantities grown locally (e.g. Bulgaria, Croatia), are typically handled by gourmet food wholesalers. Because of the limited shelf life of the fresh truffles and their cost the dominant form of transport is in refrigerated packaging. This way the truffle can be kept 10 to 12 days, which is necessary but enough for proper distribution.

4.5 Price

From year to year and during any particular season, prices paid to the grower or collectors vary due to availability and quality. The average price paid for fresh high quality *Tuber uncinatum* is 140 Euro/kg, but this price also has a large fluctuation scale from 60-170 Euro/kg depending on the season.

Fresh truffle prices are heavily dependant on the following features:

- Availability - scarcity based on seasonal conditions has a marked impact on price but only if the quality is high
 - Flavour - if harvested too early the flavour is not so well developed
 - Freshness - as the truffle ages it can become most malodorous depending on the type of fungi or bacteria involved in its breakdown
 - Lack of damage - lack of insect attack or bacterial and fungal infections is most important

4.6 Promotion

In the formative stages of the business as trees are being bought and the truffière is established, well targeted advertisements promoting the prospective product should be done to generate sufficient interest and commitment to the sale.

As production commences and truffles are harvested the markets identified will be approached directly to gain sales. Analyzing the market information we conclude that there would be no problems in selling any amount produced as long as the truffles were of good quality. Again it is expected that market penetration will be achieved with a minimum of advertising. Precisely targeted, limited distribution, high quality point of sale advertising material will be appropriate for promoting this gourmet product from Romania.

General promotion of truffles will be amplified through using activities such as:

- Special occasions at restaurants where truffles feature on the menu, e.g. even now, using imported produce, restaurants in Bucharest have constant truffle menus.
- Trade displays particularly those featuring fine foods. Internationally and locally there are regular promotional fairs (trade days), which will present an ideal opportunity to promote Romanian truffles. Involvement in international mycological and mycorrhizal fungi conferences will also be beneficial for the business.
- Cooking and catering classes.
- The Internet and the site of the Truffoir Ltd. will be a place for advertising, and it will be constantly updated with the actual truffle supply and price.

PART TWO

Economic Evaluation

5. Setting up a business

In setting up a truffle industry there are three discrete components (1) the inoculation, purchase of the plants; (2) the establishment and management of truffières; and (3) the harvesting and marketing of truffles.

5.1 Acquiring inoculated trees

Inoculated plants with *Tuber uncinatum* can be purchased from several inoculation laboratories from France or Italy. The average price of these trees varies between 920 Euro/tree depending on the tree specie and the quantity requested. The inoculation period is 12 month in special culture medium in a controlled atmosphere glasshouse, while the protection from contamination of the host plant is secured.

5.2 Setting up a truffière

The costs presented here relate to the expected cost of establishing a truffière from the perspective of the farmer (hereby the Truffoir Ltd.) and refer to the setting up of a 1 ha module.

It is assumed that the farmer is already in possession of the land to be planted out and that the opportunity cost of activities foregone on the truffière site is not material in this consideration. The inoculated trees are 9 Euro each and are planted at the rate of 800 per ha. An irrigation system with mini sprinklers is installed and the soil is assumed to require cultivation and application of lime and fertilizers. On a regular basis after establishment, ploughing and cleaning the sites are necessary, which is reflected in the recurrent expenditure on labour.

In line with the French and Italian experience it is expected that the hazel trees will start producing after the fourth year, although only in small quantities. On an optimistic note, it has been assumed that more steady production commences in the eighth year and, thereafter, production continues to increase. It is projected that the grower will receive 140 Euro per kg on average.

It would be advisable that the cost of establishing the truffière should be fully tax-deductible and able to be used to offset other sources of farm income.

Projected cash flows for growers establishing truffière (1 ha)

Outgoings

Year 0, Inoculated trees	7200 Euro
Year 0, Irrigation system	2000 Euro
Year 0, Soil preparation and lime	500 Euro
Year 0, Fence	500 Euro
Year 0+, Fertilizers	500 Euro
Year 0+, Labour	500 Euro

Income

Year 4, 5 kg	700 Euro
Year 5, 10 kg	1400 Euro
Year 6, 15 kg	2100 Euro
Year 7, 20 kg	2800 Euro
Year 8, 25 kg	3500 Euro
Year 9, 30 kg	4200 Euro
Year 10, 35 kg	4900 Euro
Year 11, 40 kg	5600 Euro
Year 12+, 45 kg	6300 Euro

*Where (+) refers to recurrent expenditure or income

The basic idea is to start the plantation with 5 ha, then enlarge it every upcoming year with at least the same size. This way after 15 years a large amount of harvest can be achieved. If we raise this extension to a rate of 15 ha per year (12.000 trees) it would take seven years to plant out a 100 ha area.

5.3 Marketing

A single marketing group is envisioned as the most effective means of coordinating the marketing of the harvest and achieving greatest control on the price. It is assumed that all the truffles produced are sold directly to either domestic or international markets or hotels.

It must be stressed on the fact that the cultivated *Tuber uncinatum* has a much convenient price then the truffle species harvested in most of the European countries, therefore there is an open window for this product to present itself in the market. Although in order to protect their interests it is expected that the French, Spanish and Italian market may provide resistance to the Romanian product, we believe that good quality truffle on this price will be consumed without problems.

6. References

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