

Black Truffles (*Tuber melanosporum*)

Elizabeth Hinsley, Research Assistant
Jeanine M. Davis, Extension Horticultural Specialist
Department of Horticultural Science
North Carolina Cooperative Extension Service
North Carolina State University

Introduction

Truffles are the “fruit” of fungi that live in the soil in association with the roots of several species of trees. These associations are mutually beneficial to the truffle and the tree and are known as (ectomycorrhizal) symbioses. Thousands of truffle species exist, but few of them are edible. *Tuber melanosporum* is the French black truffle, also known as the Perigord truffle. This truffle, named after a French province and usually grown in France and Spain, is one of the most prized delicacies in the world. They have a distinctive intense aroma and flavor that make them a highly revered culinary ingredient. Some other edible truffle species include the highly prized Italian white truffle (*Tuber magnatum*), the burgundy truffle (*Tuber uncinatum*) also known as the summer truffle, the inexpensive and rather bland Chinese truffles (*Tuber sinensis* and *Tuber himalayensis*), and the pecan truffle (*Tuber lyonii*), which can be found in the deep South, including Georgia. This publication will focus on the black truffle, but the production methods are similar for all types.

Black truffles are small and grayish-brownish black when mature, although when immature they have a reddish scaly skin. Mature truffles typically weigh between two and three ounces at maturity and range in diameter from 3/4 to 2 inches and sometimes larger. They are roughly spherical, with a nubby, cracked surface. The cracks in the truffle surface create a diamond-shaped pattern. The inside of the truffle is purplish-black, firm, and streaked with white veins, indicating maturity. When fresh, they have a delightful earthy aroma and nutty taste. The taste has also been described as a mixture of chocolate and earth.

Truffles grow in the soil around trees that have the truffle mycelium growing on their roots. In some parts of the world, truffles occur naturally. In other areas, host trees are inoculated with the fungus and planted in an orchard, also known as a “truffiere.” Several possible host trees for black truffles exist, including the common European hazelnut (*Corylus avellana*) also known as filberts, holly oak (*Quercus ilex*), and downy oak (*Quercus pubescens*). In North Carolina, filberts and oaks are commonly used as the host tree for black truffles. The first truffles should appear the sixth or seventh year after planting. Dogs must be trained to find them during the winter and early spring.

Climate and Soil Requirements

The French black truffle needs a climate without extremes in heat or cold. A temperate climate where temperatures are cold enough to induce dormancy, but not freeze the ground solid, is required. Planting is not recommended in areas where the temperature falls below 15°F for

extended periods. Temperature is important because truffles begin to form in the soil during the summer when they are vulnerable to damage from high soil temperatures and dry conditions. They mature between December and the end of February when they can be damaged if the soil freezes around them. Many parts of North Carolina, except for the high mountains and coast, should be well suited for truffle production.

While the soil type for truffles can vary greatly, it should not contain over 40% clay, sand, loam, or rock and should be well-drained. The suitable soil pH range is between 7.5 and 8.3, but 7.9-8.1 is considered ideal for fruiting to occur. This is a challenge in North Carolina because the soils are naturally acidic. Liming the soil heavily for several years, however, will slowly raise the pH, encouraging the truffle mycelium to grow and finally to fruit. The task for the truffle farmer is to add lime incrementally until the ideal pH is reached. Lime can take as much as a year to change the pH of the soil, and it is often difficult to add enough lime in a single application, so the process of applying lime is necessarily gradual. The lime should be worked at least eight inches into the soil. Once the ideal pH is reached it will need to be maintained with supplemental lime applications as necessary since natural soil processes will reduce pH over time.

Host trees can be planted before the soil pH reaches the ideal level for truffle production. Filberts will actually become established faster at a pH of 7.2-7.4. The quicker the pH is raised into the ideal range, however, the less likely other competing fungi are to become established on the roots of the host trees. One approach is to raise the pH all the way to 7.9 before the trees are planted to give potential competitors as little opportunity as possible to exploit non-ideal conditions, but few farmers are willing to wait that long before planting.

Site Selection and Preparation

The natural habitat for black truffles is on sunny slopes and plateaus, often with a south or west orientation, but many successful truffle orchards are on flat ground and/or facing other directions. A well drained soil is critical, especially in areas prone to high rainfall. It is usually necessary to be able to drive on the site to apply lime, till, or mow, so the orchard site should not be too steep. The site for truffle production must not have had other ectomycorrhizal trees on it for at least a few years before planting the truffle trees. Ectomycorrhizal trees, those that host other fungus species on their roots, include many conifers, oaks and other nut trees, and some shrubs, particularly manzanita. Most fruit trees, maples, and other ornamentals are not ectomycorrhizal and do not present a problem. If trees are growing on the proposed site, they should be completely removed, including stumps and roots, at least six months prior to planting the truffle host trees.

The site should be plowed prior to planting to remove existing vegetation and prepare the soil for planting. Any lime and/or fertilizer applications are easiest at this time before the trees are planted. This is also the most practical time to install buried irrigation lines.

Planting the Orchard

To cultivate truffles, inoculated truffle trees are generally planted in orchards much like those for fruits and nuts. Arrangement and spacing of the trees is a subject of some debate and different

approaches are used. Generally speaking, black truffles grow beneath relatively isolated trees or trees at the edge of forests in its natural habitat. Thus, many orchards in Europe are fairly sparse with 100 or fewer large trees per acre. In other cases the trees are packed close with as many as 1,000 trees per acre to encourage the movement of the fungus from one tree to the next through vegetative growth of the fungal mycelium. The spacing of the trees also depends to a large extent on the size of the tree species used, soil fertility, and the willingness of the farmer to thin the trees when they begin to crowd, possibly removing some that may be producing truffles.

It is not necessarily true that more trees will produce more truffles. Trees stressed by overcrowding may have fewer resources to give to the truffles and closure of the canopy is generally considered harmful to survival of black truffles. Further, while root contact between trees will facilitate spread of truffle mycelium, it also facilitates vegetative spread of competing fungus species. Orchards established with high densities are fine when the trees are young and small, and by having more trees the likelihood of early production increases, but they must be thinned later to prevent crowding.

Until research is done to determine the optimum spacing for North Carolina orchards, 500 filbert trees per acre in rows 12 feet apart, with a space of six feet between trees is recommended. With oaks, the spacing is 18 feet by 18 feet. The faster the soil is fully colonized, the faster truffle production will begin. Trees should be planted well before bud burst in the spring. Holes can be dug by hand or with a mechanical augur to a depth of approximately 10 inches and a width of at least 4 inches. When filling the hole to bury the roots of the truffle tree, the soil should be broken up to eliminate clods so that no voids are left around the tree's roots. The roots should be buried to just above the root crown. Drenching the soil in the planting hole with water after planting will collapse any remaining void spaces making better contact between roots and soil and it will improve growth and survival through the first year.

Truffle Orchard Management

Since the soil must remain moist, particularly in the summer, irrigation should always be available in a truffle orchard. During the first year or two, irrigation may be necessary just to ensure survival of the trees. Do not plant an orchard expecting to install irrigation later. Install it prior to, or at the time of, planting. Irrigation can be supplied with an underground drip irrigation system or an overhead microsprinkler system.

Where rabbits and deer are common, the young trees should be protected from browsing until they grow large enough to endure it. Plastic tree guards, that wrap directly around the trunk of the tree, or hardware cloth collars attached to stakes in the ground, can be used.

Once the trees are planted it is very important to control weeds and grass growing near them. Grass and broadleaf weeds can compete with the young trees and the truffle mycelium for water and nutrients. At this early stage the soil under the drip-line of the tree should be kept free of vegetation and by lightly tilling or hoeing within a few feet of the trees to prevent weed establishment. Expect to do this at least twice a year for the first three years. An organic mulch, such as straw, may be applied around the trees to prevent soil erosion, retain soil moisture, moderate soil temperatures, and retard weed growth. Be alert, however, for voles or moles that

might hide in the mulch and damage the bark. A cover crop, such as clover or grass, can be established in the aisles between the tree rows. This should be kept mowed. Starting in the fourth year, the whole orchard should be disked every spring to a depth of about two to three inches. This should be done every year. Trees may be pruned into a cone with the point facing down to maximize penetration of sunlight through the canopy and warm the soil. Care should be taken to avoid tilling too deeply and damaging roots, and to avoid over-irrigation.

Harvest and Yields

In filbert orchards, truffles begin to appear between four and six years after the inoculated seedling trees are planted. The trees should be in full production between eight and ten years after planting. Oak trees may not start producing until 10 years after planting and can be expected to be in full production between 12 and 15 years. The onset and duration of production depends to some extent on the species of host tree, but in both filbert and oak orchards, truffle production can continue for decades.

Black truffles start to grow in spring and summer and are harvested from mid November through mid March. Truffles can be found anywhere from 2 to 15 inches below the soil surface, usually in a circular formation about four to five feet from the base of the host tree. Truffle harvesting is a delicate operation. Because truffles remain underground even after maturing, the acute sense of smell of certain animals is required to find them. Traditionally pigs were used to locate and dig up the truffles, but they are being replaced by dogs. The fine sense of smell of the pig makes it very efficient, but there is a high risk of truffles being unearthed with the snout and being damaged, or even swallowed. Unlike pigs, dogs are not naturally interested in eating truffles and can be trained to indicate with a paw the place where they scent a truffle. Although no race of dog instinctively looks for truffles, hunting dogs are not used as they are more inclined to sense game than truffles. Typically, dogs are trained to use scent to find the location of the truffles and scratch the surface of the soil to identify their location. At that point, the truffle grower digs in that spot to find the truffles. The presence of mature truffles ready for harvest can also be indicated by swarms of flies hovering over the area where truffles are growing. Ripe truffles can also be signified by the lack of plant life at the base of the host trees.

Yields vary dramatically: some farms produce as much as 150 lb per acre each year while others produce little. Typical yields in Europe range between 25 and 35 lb per acre each year, but as methods improve many more farms are achieving yields in excess of 100 lb per acre. In the U.S., one acre will usually yield about 75 lb of truffles per year.

The black truffle has a fresh shelf life of only three weeks, after which there is a rapid deterioration in quality. Accordingly, timely post-harvest handling and distribution to market is essential.

Market

Truffles are among the world's preeminent culinary delicacies. Retail prices in the U.S. for the French black truffle or Perigord truffle, and the Italian white truffle, have reached \$1,000 and \$3,000 per pound retail. Most truffles are harvested in the wild and since the wild supply is

diminishing, prices continue to climb. At the end of the nineteenth century, the French produced an estimated 1,500-2,000 tons of truffles per year. Now, it is estimated that only about 120 tons of truffles are produced annually worldwide. In 2004, the retail price for fresh black truffles in some markets rose above \$2,000 a pound. Wholesale prices usually range between \$200-\$400 per pound.

Growers can sell their truffles wholesale to food brokers, restaurants and caterers or retail to consumers at tailgate and farmer markets. Other marketing opportunities exist with the internet, mail order, and classified ads in local newspapers and trade publications. Production and sales of value-added products, such as truffle oil and butter, are other ways to increase profits from truffles.

References

Garland Gourmet Mushrooms and Truffles. www.garlandtruffles.com. Retrieved on September 29, 2005. Also see <http://indyweek.com/durham/2004-03-17/dish2.html>. This company is a source of inoculated trees.

Gourmet Foodstore. www.gourmetfoodstore.com/truffles/types-truffles.asp. Retrieved on October 6, 2005.

Hall, Ian. *Tuber melanosporum - Périgord black truffle*. New Zealand Institute for Crop & Food Research Ltd.

New World Truffieres, Inc. <http://www.truffletrees.com/index.html>. Retrieved on September 26, 2005. This company is a source of inoculated trees.

Perigord Truffles of Tasmania. www.perigord.com.au. Retrieved on October 6, 2005.

Wikipedia, the free encyclopedia. http://en.wikipedia.org/wiki/Truffles#Methods_of_production. Retrieved on September 26, 2005.

Further Reading about Truffles

Aurora, David. 1986. *Mushrooms Demystified*, 2nd edition. Ten Speed Press: Berkeley, CA.

Chang, Shu-ting, and Hayes, W.A. 1978. *The Biology and Cultivation of Edible Mushrooms*. Academic Press, Inc.: Orlando, Florida.

Hall, Ian. 1994. *The Black Truffle: Its History, Uses and Cultivation*, 2nd edition. New Zealand Institute for crop & Food Research Limited: Christchurch, New Zealand.

