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Introduction



Welcome to the EFFNZ website!

EFFNZ Ltd have developed the De Licio® brand of truffle and mushroom mycorrhiza infected seedlings to help change pasture or existing forests into a viable truffle or mushroom producing crop.

Our aim is to provide plantation forestry owners, and lifestyle farmers with the opportunity of producing an annual crop of truffles or edible mushrooms in plantations that otherwise would not produce significant income until the trees are felled. We anticipate that forests producing significant income are less likely to be felled early and this may have positive implications for the accumulation of carbon credits.

Take some time to browse the info and if you are after a good read there is a downloads section at the bottom of the website pages to get you started!



So why should you grow truffles or mushrooms?

There are several reasons you may be interested in getting involved in New Zealand's rapidly growing truffle and mushroom industry.

1. Be a pioneer! This is a relatively young industry in the country and so far it has been through the efforts of several determined individuals that the possible rewards are being seen.
2. A successful edible ectomycorrhizal mushrooms (EEMM) crop will offset the cost of establishing the plantation and under some circumstances the harvested truffles or mushrooms may exceed the value of the timber!
3. Even modest quantities of truffles and mushrooms may be sufficient for a grower to be able to delay felling a plantation until timber prices are optimal.

The financial rewards can vary but truffle yields tend to be lower per tree than the other edible mushrooms but prices can be much higher and well in excess of NZ\$1000 per kg.

New Zealand's first commercial saffron milk cap plantations produced their first mushrooms 18 months after planting in 2001. Production is now 3 kg per tree with the mushrooms selling for NZ\$40/kg.

Many of the host trees for mycorrhizal mushrooms also produce quality timber or edible nuts so there is also the opportunity for double cropping.

About EFFNZ



Edible Forest Fungi New Zealand (EFFNZ), Chowbent, Truffles & Mushrooms Consulting Limited and Oregon Nurseries Ltd are four companies involved in the cultivation of ectomycorrhizal mushrooms. They have come together to develop new ways of cultivating EEMM such as truffles and the saffron milk cap and to provide pre and post planting management advice.

Background

Mycorrhizas



All the major forest species and most agricultural and horticultural species have mycorrhizas (pronounced my-core-rye-zas), beneficial, symbiotic relationships between certain fungi with the roots. The fungus gets carbohydrates from the plant and a place to live and, in exchange, the fungus supplies the plant with minerals, in particular phosphorus. Mycorrhizas fall into two groups: ectomycorrhizas where the fungus is predominantly on the surface of the root, and endomycorrhizas where much of the fungus is inside the root.

Mycorrhizal Mushrooms



Most commercial mushrooms are grown in factories where the artificial conditions are managed to ensure quality products, maximum yields and greatest profit. The button mushroom, shiitake, oyster mushroom and straw mushroom all fall into this category. Another group are formed by ectomycorrhizal fungi. While the Périgord black truffle and the Italian white truffle are regarded as the diamonds of the mycorrhizal mushrooms, there are over 1000 species and some are in great demand with prices ranging from a few tens of dollars up to several thousand dollars per kilogram. For example, porcini and the chanterelle together have a market worth more than £1 billion. Like the vast majority of mycorrhizal mushrooms, porcini and chanterelle have never been cultivated and supplies are collected entirely from the wild.

Progress has been pedestrian since the Périgord black truffle was first cultivated in the first half of the 19th century. However, over the past 30 years scientists have begun to unlock the secrets to growing other mycorrhizal mushrooms and the wonderful array of flavours they have to offer. They have also imported these very seasonal mushrooms into the Southern Hemisphere where they can be grown out-of-season to the Northern Hemisphere. De Licio® was established to produce trees mycorrhized with edible mycorrhizal mushrooms for establishing specialised plantations or the production of secondary crops in plantation forests.



Edible mycorrhizal mushrooms in plantation forestry



Mycorrhizal mushrooms grow on a variety of plantation forest species familiar to the New Zealand forester. However, the initial treatment the mycorrhized trees receive is somewhat different from the two slots in the ground with a spade and heeling in that a plantation forest tree might receive. The minimum tree specifications that a forester might expect are also unlikely to be met because the mycorrhized trees are raised under specialised conditions in a greenhouse and are planted when the trees are adequately mycorrhized even if relatively small.

Breakthrough



The first mycorrhizal mushrooms to be cultivated were the Périgord black and the Burgundy truffles back in the first part of the 19th Century. Some 150 years later scientists have begun to unlock the secrets of a few other mycorrhizal mushrooms and the wonderful array of flavours they have to offer. They have also learnt how to grow these very seasonal mushrooms in the Southern Hemisphere out-of-season to the Northern Hemisphere. Each of the mycorrhizal mushrooms with their host trees require a unique set of conditions to grow and fruit. The bianchetto truffle will fruit on more than a dozen host trees such as the stone pine, hazel and English oak but only if they are planted in high pH, lime-rich soils and in areas with warm summers. The painted suillus only grows on Douglas fir and in relatively low pH, free-draining soils, in sheltered areas between 300 m and 800 m in the North Island, such as on the volcanic plateau, and up to 700 m in the South Island. The saffron milk cap only grows on acidic soils suited to radiata pine and has been found to fruit from just north of Dunedin to Nelson in the South Island and as far north as Gisborne and the Waikato in the North Island. We are confident it will also grow in Southland.

Benefits



The harvest and sale of truffles or mushrooms during the life of a forest will offset the cost of establishing the plantation and, under some circumstances, the income from the sale of the truffles and mushrooms may exceed the value of the timber. Even modest quantities of truffles and mushrooms may be sufficient for a grower to delay felling a plantation until timber prices are optimal.



What are my options?

Saffron Milkcap



The saffron milk cap mushroom (*Lactarius deliciosus*) has been eaten in Europe since Roman times and is still greatly appreciated in Europe, and in particular Portugal and Spain, for its mild, slightly bitter flavour. It has made the accidental journey to Australia probably on the roots of imported trees and is found in pine forests throughout the southeastern part of the country where it is collected for the restaurant and gourmet trade. It is easily recognised by the saffron-coloured sap it bleeds when damaged, the concentric rings of carrot-coloured blotches on the surface of the cap, and its tendency to turn green with age or after being handled. Grade 1 saffron milk cap typically wholesales for NZ\$40 and A\$40/kg whereas in Spain top quality mushrooms retail for €40/kg.

Sometimes the saffron milk cap is confused with a lookalike mushroom called *Lactarius deterrimus*. This is less palatable and a disappointment when it finds its way into a meal. There are also some poisonous lookalikes such as the woolly milk cap (*Lactarius torminosus*). A few have also mistaken poisonous brown roll rims (*Paxillus involutus*) for saffron milk caps.

Because the saffron milk cap grows associated with pines and spruce with which it forms a mycorrhizal association, it can only be cultivated in plantations established with specially inoculated trees. These mycorrhizal trees can be planted and managed exactly as a normal pine plantation but yields can be much higher if special management practices are followed such as irrigation during dry summers. The profitability of the plantation can be further boosted if the mushrooms are harvested and transported to the market properly.

The first New Zealand saffron milk cap infected trees were planted in August 2000 and mushrooms were produced after only 18 months. The first commercial crop was sold in 2003 by Hannes and Theres Krummenacher near Nelson. In 2009 this plantation averaged 4 kg per tree in its 9th year after planting and the total mushrooms produced so far produced per tree far exceeds the value of a 30 year old well pruned radiata pine. The saffron milk cap has fruited from Gisborne to just north of Dunedin but it should also grow in cooler parts of the country

Bianchetto White Truffle



When young the bianchetto white truffle (*Tuber borchii*) strongly resembles the more expensive Italian white truffle (*T. magnatum*) with which it can be accidentally, or deliberately, confused. The aroma of bianchetto is also similar to the Italian white truffle, although a little more garlicky. The main differences between the two species is that bianchetto is harvested during winter and early spring while the Italian white truffle is harvested in autumn and early winter. Also at maturity bianchetto turns light brown to reddish brown often with irregular dark brown patches and the insides become coffee-coloured to dark brown criss-crossed with a network of fine white lines. The two species can also be distinguished by differences in the ornamentation on the surface of their spores. In Italy bianchetto range from pea sized to that of an egg but cultivated New Zealand truffles can weigh more than 125 g and are the size of a tennis ball. Unlike the Périgord black truffle the surface of bianchetto truffles are not ornamented but covered in tiny hairs giving them a suede-like appearance under the microscope.

Although an excellent truffle bianchetto was undervalued in Italy in the past because it was often sold mixed with similar looking but poorer flavoured species such as *Tuber maculatum* (a species commonly found in New Zealand), *Tuber dryophilum* and *Tuber puberulum*. These spoil the flavour of food containing them, a problem that persists in Italy and does nothing for the truffle industry as a while.

Bianchetto truffles have been found from just north of Edinburgh, in the north to Sicily and Sardinia in the south. The bianchetto truffle was first cultivated in Italy in the late 1990s and the first commercial harvest in the Southern Hemisphere was made by Jeff Weston in Autumn and Winter 2008 at West Melton, near Christchurch, New Zealand. Retail prices in Italy can be higher than €500/kg but off-season truffles produced in New Zealand can fetch much higher prices which currently hover around NZ\$3000/kg for grade 1 truffles.

Bianchetto has a very wide host range which includes beech, black poplar, hazelnut, oaks, European limes, cedar, larch and pines. In New Zealand it has fruited on the common hazelnut, English oak, stone pine and maritime pine. It is known that bacteria and other soil microorganisms can be beneficial to the relationship a mycorrhizal fungus has within its host plant. The methods that Edible Forest Fungi New Zealand Ltd uses to produce its plants takes this into account.

Painted suillus



Douglas fir (*Pseudotsuga menziesii*), like all of the major forest trees of the world, is dependent on mycorrhizal fungi that inhabit its fine roots. Without these mycorrhizal fungi Douglas fir would become yellow and stunted through a lack of phosphorus and other nutrients supplied by the fungus. Some of the mycorrhizal fungi produce edible mushrooms and one of the choice ones on Douglas fir is the painted suillus (*Suillus lakei*). So close is the bond between the painted suillus and Douglas fir that the fungus will not grow on any other species of tree. If it is found under a different tree then invariably there will be a Douglas fir nearby.

Mature painted suillus caps are from 4 cm to more than 15 cm in diameter and the stalks are up to 10 cm high and 4 cm wide with a poorly developed ring close to the top. When mature the upper surface of the caps are covered in characteristic divided scales arranged in irregular radial rows.

The undersides of the caps are covered by yellow pores that often run a little way down the stalk. As the caps age the pores become a dirty yellow to ochre with light brown patches where damaged. When rubbed the insides of the caps turn a greenish blue. Other common species of *Suillus* do not do this. For example, young caps of the larch bolete (*Suillus grevillei*) turn light brown.

Normally eaten by North Americans, New Zealanders may need introducing to its flavour. It should be collected when the caps are mature and dry and not when very young and in wet weather when the caps are often gelatinous.

The painted suillus can be used in a variety of dishes where porcini might otherwise have been used such as soups, stews and casseroles. A snack treat can be made by first removing the pores from the fleshy cap and then fast frying slices in hot olive oil - a lingering aroma and a superb flavour. The painted suillus omelette described by Freyburger (http://fungi.0catch.com/Suillus_lak.htm#Recipes) is very good particularly if the caps are browned in the pan first.

More than 500 mycorrhizal fungi can be found on Douglas-fir in its natural habitats but in planted Douglas fir forests in Patagonia (Argentina) only 15 species of mycorrhizal fungi can be found. A similar situation occurs in New Zealand which means there is less competition for the painted suillus in New Zealand's Douglas fir plantations. Where conditions suit the painted suillus fruiting body production can be very high particularly on poor, exposed, mineral soils. Production in the Douglas fir plantation shown in the photograph below was estimated to be not less than 1kg per hectare.

Is my site ready?

Ecological Requirements



It is extremely important to note that each of the mycorrhizal mushrooms along with their host trees require a unique set of conditions to grow and fruit. If you help build these ecological conditions and requirements then you have just raised the chance of not only producing truffles or mushrooms successfully but giving them a chance to have a much larger harvest.

The bianchetto truffle will fruit on more than a dozen host trees. Examples include the stone pine, hazel and English oak. It also needs a high pH, lime-rich soil and areas with warm summers and cool winters. In New Zealand it has been cultivated in Te Puke, Waipukurau and West Melton, near Christchurch, whilst in Europe it fruits from just north of Edinburgh to as far south as Sicily.

The painted suillus only grows on Douglas fir and in relatively low pH, free-draining soils, and in sheltered areas between 300 m and 800 m in the North Island, such as on the volcanic plateau, and up to 700 m in the South Island.

The saffron milk cap only grows on acidic soils such as those suited to radiata pine. In New Zealand it has fruited from just north of Dunedin to Nelson in the South Island and as far north as Gisborne and the Waikato in the North Island. Because it grows widely in Scotland we are confident it will also grow in Southland.

The Burgundy truffle is widespread throughout Europe and fruits well from as far north as the island of Gotland off the east coast of Sweden to the warmest parts of Europe. In New Zealand a few Burgundy truffles have been found south of Oamaru.

Almost all of the edible mycorrhizal mushrooms fruit in autumn (e.g. saffron milk cap, painted suillus, porcini, Burgundy truffle) or winter (bianchetto truffle and Périgord black truffle) while a few can occasionally be found fruiting in spring (e.g. porcini).



Ordering

Ordering your seedlings



In theory you have established which crop your site is best suited for and the number required. So now you are ready to order some seedlings!

There are 2 quick ways you may place your order. The first would be to download and fill in the following relevant forms from the website (located at the bottom of each page):

[EFFNZ 2009 Price List](#)

Here is a copy of the De Licio® inoculated plant price list and relative documentation available for purchasing.

[EFFNZ 2009 Order Form](#)

This order form will need to be filled out so we can put your trees aside.

[Terms and Conditions](#)

EFFNZ Terms of Conditions. This is very important to read just so you know the circumstances involved in making a purchase.

The second would be to get in direct contact with Kevin Fearn for availability of trees bearing edible mycorrhizal mushrooms:

Kevin Fearn
Edible Forest Fungi NZ Ltd
P.O. Box 384
Oamaru
New Zealand

Phone: +64-3-431 3627

Mobile: +64-27-450 4605

Email: kevin@oregonnurseries.co.nz

Once your order is placed you will be informed on availability of stock and an approximate dispatch date based on when the seedlings are ready and your sites location.

You may choose to pick up your seedlings or have them sent to you. Carrier will be discussed closer to dispatch date. If you have a preference let us know as soon as possible.

Remember upon arrival of your seedlings follow the planting instruction in the next step. Most importantly get the plants in the ground as soon as possible.



Planting

Plant Density



The density required for truffle mycorrhized trees is dependent on a variety of things including the species of truffle and climate in your area. Detailed information on this can be found in the book "Taming the Truffle" by Ian Hall, Gordon Brown & Alessandra Zambonelli. Copies are available from Ian Hall. For non truffle mushrooms standard plantation forestry densities can be used, 3 m x 3 m for radiata pine and even higher for Douglas fir.

Planting Instructions



We recommend that you do not store trees before planting so make sure your soil and everything else is ready before you take delivery of your trees. If for any reason you absolutely must delay planting make sure that you water the plants regularly but without overwatering and don't store them near or under ectomycorrhizal trees because these could contaminate your trees. If you are not sure what plants form ectomycorrhizas download the file "Lists of arbuscular mycorrhizal plants suitable for windbreaks around truffières and unsuitable ectomycorrhizal plants" from www.trufflesandmushrooms.co.nz Under no circumstances should you store trees in leaf inside a darkened room such as a garage.

Trees that carry edible mycorrhizal mushrooms such as the saffron milk cap, come in a variety of containers such as special slotted trays constructed to stop root spiralling, black polythene planter bags, and paper-like bags (Melfert bags). If you have purchased plants that have been raised in black polythene planter bags or from suppliers other than De Licio® you should contact them for planting instructions

Early Spring planting is preferable, late July in, for example, Gisborne, and late August or early September in the cooler parts of the country. The one exception is where the African black beetle is common. Although this beetle normally lives on pasture species it is not too particular and can ring bark young radiata pine, oaks and hazel. Consequently, wherever the African black beetle is found we recommend planting in late January or February.

Irrigation is strongly advisable as is some form of tree protection at least until the tree roots have grown out of the potting mix and into the surrounding soil. In these regards all trees mycorrhized with edible mycorrhizal mushrooms are initially treated like truffle trees (see Taming the Truffle).

Plant during dull, overcast conditions when there is not much wind. Do not plant in full sunlight or in windy conditions. This is because the trees do not have access to much water in their containers and can dehydrate in a matter of hours. This might set back their growth by months if not permanently. Plants that have been raised in slotted trays can be planted directly into the planting hole without prior treatment. It is impossible to remove Melfert bags (photo in the right hand column) and instead these should be cut top to bottom in three places around the bag before planting. Plant the trees so that the root ball is just covered by the soil to a depth of about 1 cm. Irrigate once or twice daily to begin with and make sure that the irrigation water is penetrating to a depth below the roots of the plants and not just the top few centimetres of soil.



Plant & Site Maintenance

Maintenance of trees



Where there are browsing animals such as hares and in windy areas there are considerable advantages from protecting your trees with tree guards or tree shelters. In the Périgord black truffle industry and on Jeff Weston's productive bianchetto truffière, 600 mm (high) x 150 mm KBC Tree Guards have been successful (available from, for example, Newfield Marketing, Christchurch, 03-348 0799) although a range of other products are available such as Tubex Shrubshelters (see "Taming the Truffle", p. 138).

We have not observed any problems associated with high temperatures inside Tree Guard boxes providing there has been adequate irrigation. However, if your plantation is in the hotter parts of New Zealand it would be worthwhile talking to other growers, garden suppliers, nurserymen, etc., and asking for their experiences. Cutting a line of vertical holes with a rotary saw at the lower end of the boxes will help convection currents to develop inside and cool the trees.



Ecological Requirements

Although we have covered this earlier it is an important part of a successful truffle or mushroom crop to maintain the crops needs.

Each of the mycorrhizal mushrooms along with their host trees require a unique set of conditions to grow and fruit. The bianchetto truffle will fruit on more than a dozen host trees. Examples include the stone pine, hazel and English oak. It also needs a high pH, lime-rich soil and areas with warm summers and cool winters. In New Zealand it has been cultivated in Te Puke, Waipukurau and West Melton, near Christchurch, whilst in Europe it fruits from just north of Edinburgh to as far south as Sicily.

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Harvesting

Yields & Returns



Although Périgord black truffles have been grown commercially since 1997 the cultivation of other edible mycorrhizal mushrooms is still very much in its infancy in New Zealand. Consequently there is insufficient information available to allow us to predict what yields can be expected in all parts of New Zealand. All we can do at this stage is to quote what a few growers have achieved.

In most saffron milk cap plantations between Te Kuiti and coastal North Otago, fruiting started when trees were about 2 years old. On Hannes and Theres Krummenacher's irrigated saffron milk cap plantation near Nelson, yields were estimated to be 60 kg/ha after 2½ years, 1 kg/tree in the 6th year and an average of 4 kg/tree in the 9th year. On the summer-dry site in North Otago the best plants produced 20 relatively small mushrooms whilst others have yet to fruit. This plantation was established on the boundary of a 20 year old radiata pine plantation and contamination from it may have had detrimental effects on yields. In mature plantation forests annual yields of both the saffron milk cap and painted suillus have exceeded 100 kg/ha.

The Périgord black truffle has yielded best in the warmer parts of New Zealand whereas fruiting of the bianchetto truffle has been satisfactory at West Melton near Christchurch. It is too early to predict what quantities of bianchetto can be expected from plantations but 20 kg/ha after 8 years is probably not an unreasonable expectation with yields hopefully increasing over the following decade.

In New Zealand prices charged for the saffron milk cap have been around NZ\$40/kg whilst retail prices in upmarket stores in Portugal and Spain, where the saffron milk cap is highly regarded, are around €40/kg. In New Zealand, first grade bianchetto truffles uncontaminated with poorer flavoured species, such as *Tuber maculatum* (this is sometimes called the New Zealand white truffle), are selling for upwards of NZ\$2500/kg (plus GST) at the farm gate during the winter harvest. In Italy, bianchetto mixed with some poorer flavoured truffles wholesales for about €500.

What to do, Where to go



Information on the cultivation of truffles can be found in the book *Taming the Truffle* by Ian Hall, Gordon Brown and Alessandra Zambonelli. Other edible mycorrhizal mushrooms are covered in a series of information sheets and detailed booklets that have been prepared by Truffles and Mushrooms (Consulting) Limited.

These are available from:

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To enquire about the availability of trees mycorrhized with edible mycorrhizal mushrooms please contact:

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