GROWING MUSHROOMS for Profit

The Definitive Step-By-Step Guide to Growing Mushrooms at Home for Profit

JAMES MACKENZIE

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MUSHROOM Recipes

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Contents

Introduction

As a firm supporter of local enterprise, I had an idea that I wanted to start producing home-grown goods. But not just any home-grown goods something everybody enjoys yet not farmed locally by many people.

I use organic produce when I can, so I thought to myself, why not grow mushrooms. I did not have a large space to cultivate rows and rows of vegetables so I looked at growing something that needed minimum space.

People have been consuming mushrooms for a long time and even the diminutive button mushroom has become a staple ingredient in the classic American pizza! I was drawn so much to the idea of cultivating mushrooms that I had to find out how to do it. Usually I visit friends and acquaintances first before I start reading any books.

The problem was, I didn't actually know anyone who knew how to cultivate mushrooms. I headed to my local library and I started poring over the available literature on mushroom cultivation.

I discovered a lot of surprising things about mushrooms. The more I read about growing mushrooms the more excited I became at the prospect of having my own mushroom enterprise.

It didn't take long before I was preparing the substrates needed for my mushroom farm and harvesting the first fruits of my hard work. You can do this too as long as you love what you are doing!

Mushroom farming can be a great source of income, but you have to understand the basic processes involved to make a success of it. Hopefully this book will help you in understanding those processes a little better.

What are Mushrooms?

Mushrooms are one of the most widely consumed foods in the world. A large number of mushroom varieties are used in pharmaceutical and culinary settings around the world.

Several questions need to be answered:

- What is a mushroom?
- Why does it grow on old, rotting logs?
- Is the mushroom related to plants like oregano and water hyacinth?

When taxonomists first laid their eyes on mushrooms, they had a hard time classifying them, because they showcased both plant-like and animal-like characteristics. In the old classification system, the mushroom was described as being more plant-like. Today, we now know that mushrooms belong neither to the Plant Kingdom or the Animal Kingdom.

Rather, these ubiquitous fruiting bodies are produced by species from the *Kingdom Fungi*. Yes, mushrooms are related to the annoying stuff that grows in between the bathroom tiles. And yes, not all mushrooms are pleasant to the taste (or even edible).

This is one of the biggest reasons why you should never attempt to cultivate mushrooms on your own without having a reliable guide, because you could end up spending a lot of cash without producing the mushrooms *or* cultivating the wrong type of mushroom.

Now, the mushrooms that we actually use when we cook risotto or pizza are actually the fruiting body of the fungi. The fruiting body's main function is to ensure the survival of the next generation of fungi.

A mushroom develops from a very small point on the surface of the substrate or growing medium. This tiny point (which is usually only two millimeters

or less in measurement) is called the primordium.

If we were to liken the mushroom to a regular plant, then the primordium is like the sprouting *seed* of the mushroom. Take note, however, that fungi creates a massive network of roots *underneath* the substrate.

So, the part of the fungi that you see on the substrate is just the fruiting body. So even if you pull out the fruiting body, fungi will still thrive in the same spot, because the "underground" root network of the fungi is untouched.

It is common to see clumps of mushrooms growing together in a very small area. The reason for this clumping is that buttons, or primordiums, tend to sprout near developing mushrooms. So if you look for mushrooms in the wild, chances are you will see wild clumps that showcase mushrooms in varying stages of development!

The umbrella-like structure is formed by the mycelium. The mycelium is the component of fungi that is capable of producing fruiting bodies. This component in turn, is composed of a massive amount of hyphae. Hyphae are simply the individual threads or strands that compose the entirety of a fungus' mycelium.
When a fungus' primordium is ready to be transformed into a fruiting body (a mushroom), hyphae begin to bunch together and move upward from the substrate. Early in a mushroom's development, the primordium looks like an uneven egg surrounded by a thick mass of threads (the hyphae). Over time, the dome of the egg begins to grow in size.

The hyphae veil surrounding the dome of the growing mushroom will eventually expand and rupture when the time is right. When the veil protecting the growing mushroom disintegrates, it usually becomes a part of the fruiting body.

Sometimes, the hyphae veil becomes a small, cup-like appendage on the base of the fruiting body. So, when you see some irregularities near the base of a mushroom, you know what they are.

It should be noted that not every species of mushrooms will *produce* a thick hyphae veil/universal veil. Some species only produce a thin layer of hyphae that looks a lot like a spider's web. Mushrooms are able to expand the area covered by the fungus by releasing spores from its cap.

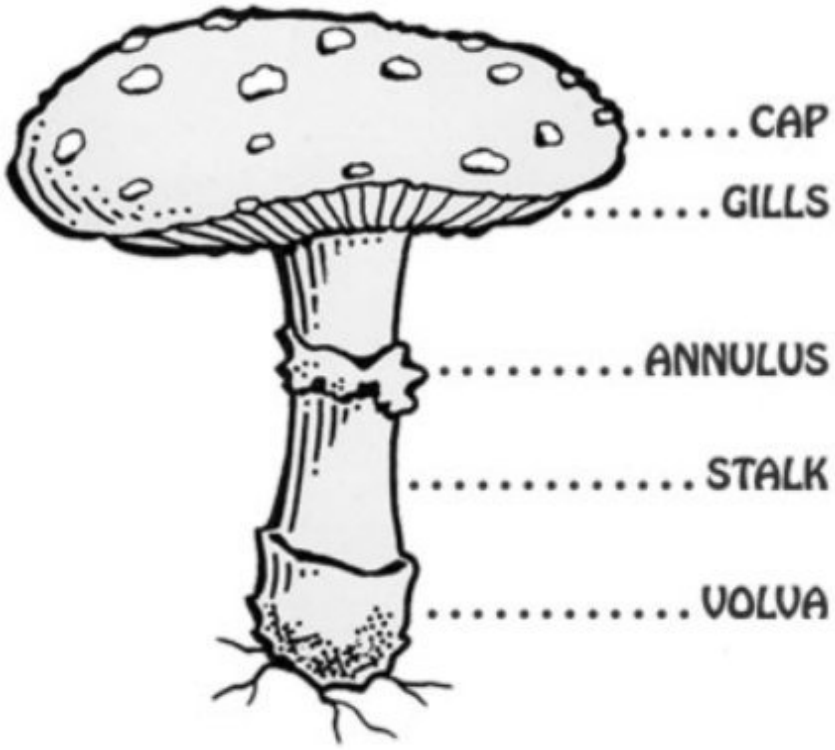
Taxonomists and mushroom enthusiasts are further able to study wild mushrooms by studying the individual spore prints of specific fungi.

Try this little experiment when you find a wild mushroom growing near your home: don a pair of sterile gloves and cut the cap of the mushroom making sure that the gills or ribs under the cap remain undamaged and undisturbed.

Place the cap gill side down on a piece of paper and leave it there for a day. After 24 hours, lift the cap and take a snapshot of the resulting pattern you see on the paper. Chances are, you will see a peculiar pattern on the paper. The "ink" that you see is actually composed of millions of fungi spores released by the mushroom within a twenty-four hour period.

You actually need an electron microscope to be able to see a single fungi spore up close, so you can just imagine how many spores there are on that single spore print. Different species of fungi produce unique spore prints. The color of the spore prints will also differ. Some species produce plain white spores while some produce violet or even black spore prints!

Mushrooms typically have five parts: cap, gills, stalk, ring, and volva. The cap is the umbrella-like structure that we are all familiar with. This is the biggest part of the mushroom and this part also plays a crucial role in dispersing fungus spores into the air.



The gills, or lamella, on the other hand are the rib-like components found under the mushroom's cap. The main function of the gills is to spread the spores of the fungi. A single mushroom can disperse literally millions of spores *every day.*
The ring or annulus is usually located near the middle section of the stalk, which is the long part of the mushroom. The stalk supports the cap and extends from the volva. The volva is composed of the rupture hyphae veil that protected the mushroom when it was just a small primordium/button.

You may be wondering: why is the mycelium so important to the whole concept of growing mushrooms?

Well, the mycelium is actually more than a source of hyphae.

The mycelium is actually the central production unit of a fungi species. Without the mycelium, a fungus would not be able to draw in or absorb the necessary water and nutrients from the surrounding area (i.e. synthetic substrate, log, or soil).

When observed with the naked eye, the mycelium looks like a mass of threads *or* a small carpet of mold. Mycelium is usually white, so it is really easy to spot the beginnings of a mushroom patch in any forest by observing the surface of dead logs. If you see powdery white splotches on the surface of a dead log, chances are mushrooms will begin to grow there!

Part 1: The Basic Process of Growing Mushrooms

In this section of the book, I am going to share with you the basic process for growing mushrooms, but later on, we are going to talk about specific procedures and information related to popular and profitable mushroom species, like the shiitake mushroom and the oyster mushroom.

Let's move on to the basics of growing mushrooms. Before you cultivate mushrooms, you need to be familiar with three essential things: the spawn, tissue culture, and the agar.

Spawn is a term that refers to the mycelium of a fungus species.

Tissue culture, on the other hand, is the process of propagating fungi on a medium. This process is also called "cloning."

The third essential element is the agar. Agar is a jelly-like substance derived from a variety of seaweed species. Agar is used by vegetarians as a substitute for jelly products that are usually derived from animal sources. This substance is widely used in mushroom cultivation because it can easily be sterilized through cooking, and the nutrient content of the agar medium can also be adjusted based on the specifications of the mushroom species that needs to be cultured.

Agar is widely available and is usually sold in packets. Unprocessed agar usually comes in powder form, and you have to manually prepare the medium based on the requirements of what you are trying to grow. Now, it should be noted that fungus mycelium will not grow just because you have added spawn to medium.

The medium itself needs to be boosted with nutrients. Believe it or not, mushroom cultivators throughout the years have used a wide variety of nutrients, including animal blood and dog food. Cooked and "boosted' agar

must be added to petri dishes (or in some cases, regular test tubes) before the medium begins to harden as its temperature goes down.

Phase One - Obtaining Pure Culture

Growing mushrooms requires four distinct phases or steps. The first step is growing the mycelium. Before active fungus mycelium can grow, (+) mycelium and (-) mycelium must be able to combine in the same nutrient-rich area.

Unlike the seeds of plants, tiny fungus spores are haploid. This just means that at any time, fungi spores will only contain half of the number of chromosomes needed for active reproduction.

One would think: if it is this complicated to create mushrooms, how do fungi do it in the wild? Well, if we look at the natural reproduction of fungi in the wild, mushrooms, or fruiting bodies, actually form when the right factors come together.

This happens by chance, but Mother Nature is extremely efficient in ensuring that even fungi can reproduce themselves without any intrusive intervention from other species. When spores are released by a fruiting body, the wind carries these spores to other places. Spores *from other areas* fly to nearby areas as well.

As you can imagine, there will eventually be a mixing of spores, and out of all those random unions of spores, a correct union will occur. This is how mushrooms are "born" in the wild.

Of course, when you are cultivating mushrooms for profit, you can't leave mushrooms to their own devices. If you do, the mushrooms may not emerge at all. You need to ensure that (+) and (-) mushroom spores unite. This can be done by combining spores in an agar medium. Starter cultures can always be obtained from suppliers, don't worry.

When a completely new culture emerges from the union of (+) and (-) spores, a piece of the culture can then be transferred to another agar medium. Over time, mycelium will begin to grow on the nutrient-rich agar medium. Mycelium can grow so well that the white, thread-like hyphae will cover the *entire* surface of the agar medium.

One of the biggest challenges at this point in time is the fact that the air we breathe is *full of wild spores*. The fruiting bodies of different species of

fungi produce spores on a daily basis. We can't smell, see, or feel these microscopic spores, but trust me; they're there, floating in the air around your house.

Most of the fungi spores that enter our homes will remain inactive or dormant until the right conditions for growth manifest. When you place a petri dish filled with nutrient-rich agar in your home, you are speeding up the process of fungal mycelium. You are providing the *right conditions* for the target fungal culture, but *also* the growth of mycelium from other species of fungi.

There will be times when your petri dish will suddenly grow mycelium from a different species of fungi. For example, if your target mycelium is white, a strange grey or black mycelium may grow right beside the target mycelium. So, what should you do when your petri dish is invaded by foreign, wild spores?

Easy – just cut out the portion of the agar that has been occupied by a different species, and transfer the excised portion to another petri dish.

Now, it should also be noted that the mycelium from another species might look a lot like your target mycelium.

So, if your petri dish has three different clusters of mycelium growing, and they're all white, chances are it is a mixture of the target mycelium and foreign mycelium.

Do not throw away the mycelium! Simply remove the other sections and transfer them another petri dish. That way, you can further observe the mycelium as it grows to see which ones are yours, and which ones are just wild mycelium from a different species of fungi.

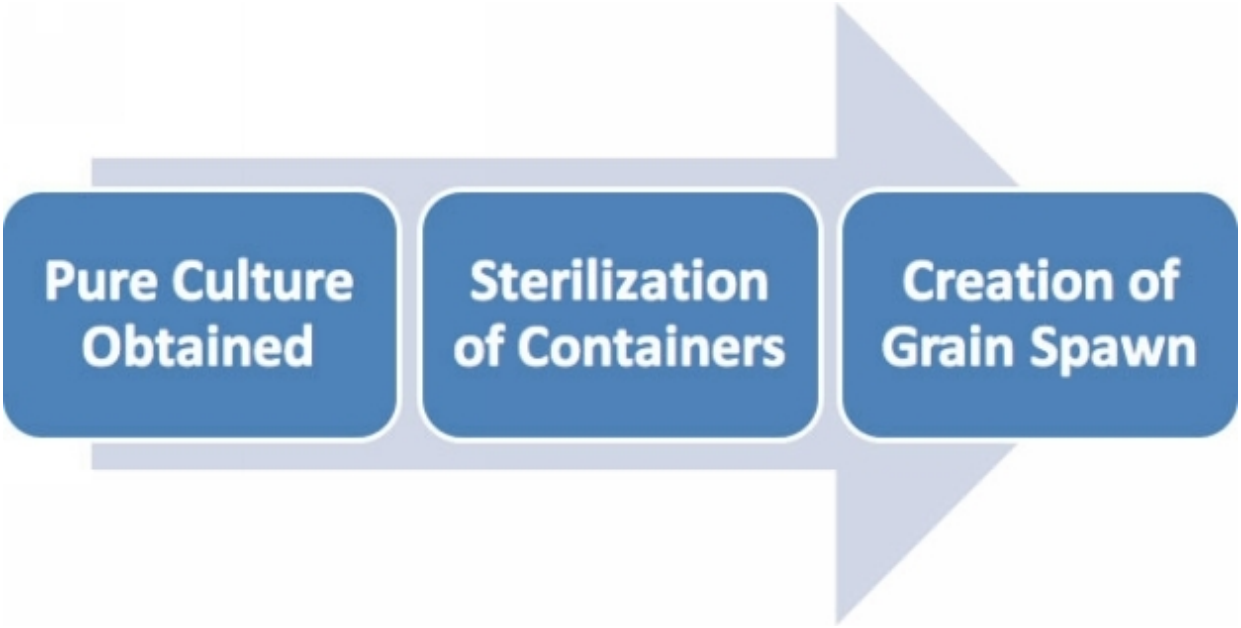
Note that the process of cutting and transferring mycelium may have to be done repeatedly until you get a pure culture of the target species. This takes time and patience, so don't give up!

If done well, fungal mycelium will grow on agar after two weeks, or 14 to 15 days. Once you are able to obtain a pure culture, you will gain two very distinctive rewards. The first reward is *knowledge.* You now know how to obtain the pure culture of target fungi!

Your new knowledge will ensure that you will always be able to obtain pure culture for your up-and-coming mushroom farm. The second reward is, of course, the pure culture itself.

Mycelium that has been cultured properly in a nutrient-rich agar medium can survive for long periods of time. In fact, you can even store your precious mycelium culture in the freezer and you can still use the culture after several months.

Phase Two - Creating Grain Spawn



The next phase of mushroom cultivation is multiplying your base mycelium on spawn.

Now that you have some pure culture of mycelium, is it possible to inoculate the actual substrate?

Not just yet! It is extremely difficult to work with mycelium that is stuck on a petri dish, so you have to let the mycelium grow some more. Rye (a type of grain) is used to multiply pure culture. Grain spawn can be created through the following steps:

The first step is to obtain the equipment and ingredients. You will need some filter paper, canning jars, can lids with a small hole in the middle, gypsum, iodine, and rye grain. The canning jar will be the new home of your grain spawn. This is where all the new action will be taking place.

The mycelium will begin to grow inside the jar, and the rye grains will act as both an anchoring medium and nutrient source.

The whole process is very easy once you have all the stuff you need nearby. The lids that you will be using will need holes because fungi need some oxygen in order to thrive.

The filter paper will be placed underneath the lid of the canning jars so that wild fungal spores will not be able to penetrate the pure culture that you are trying to create. Gypsum, on the other hand, will be used later to balance the pH level of the substrate to prevent the build-up of ammonia, which can be toxic to mushroom culture.

What about the iodine?

Iodine is a potent sterilizing agent, and a few drops will ensure that any wild spores trying to get in on the action will be neutralized immediately.

Remember: wild fungal spores are invisible to the naked eye! Don't trust the air around you. Even if your working space is relatively clean, that doesn't mean that the air around you is free from wild fungal spores.

When you have all of the supplies needed to produce the grain spawn, it's time to sterilize the rye grains. Each canning jar should be filled with approximately sixteen tablespoons of rye grain, ¾ cup of sterilized water, and 1/8 tsp. of construction gypsum.

Construction gypsum is preferred by many agricultural institutions around the world, because it gets the work done and you won't have to spend more money for any "special" gypsum that is marketed to mushroom cultivators. Place three layers of filtering paper on top of the canning jar before placing the lid and locking the lid into place.

Make sure that a hole with an approximate diameter of 1/8 of an inch has been created on the lid of the canning jar.

When the lid is finally locked into place, get an ordinary dropper and apply two to three drops of iodine to the hole in the lid. The iodine will penetrate the filter papers and will kill any rouge fungal spores that may have attached themselves to the filter paper.

The next step is to “cook” the canning jars. You will need a pressure cooker for this. An internal pressure of 15 lbs. is needed to completely sterilize the contents of the canning jars that you will be using for creating the grain spawn. Once the desired internal pressure is attained, cook the jars for at least 45 minutes.

When you are done cooking and sterilizing the jars, carefully remove them from the pressure cooker and place them on a wooden shelf or table so they can cool down. By “cool” I really do mean room temperature or better. Do not attempt to place the mycelium in a medium that is still hot from sterilization.

The medium will cook the mycelium and the pure culture might not survive! When the rye jars are cool, get the pure mycelium culture that you have stored in the freezer. With a plain butter knife, or an equivalent cutting instrument, divide the contents of the agar plate into eight separate wedges.

Since your petri dish is round, you can just cut the petri dish as you would cut a pizza or any other pie. Each jar filled with sterilized rye grain will only require four wedges of agar filled with pure mycelium culture, so each petri dish will yield enough culture for two separate jars of grain spawn.

After cutting the agar, simply drop four wedges into the canning jar. The wedges will of course just plop down on top of the rye grains. Shake the jar so that the rye grain covers the mycelium wedges. If the wedges disappear completely in the jar because of the grain, you’ve done well!

If you have healthy, live mycelium in your initial culture, your new grain spawn will emerge within a few short days. A thick swathe of mycelium will cover the rye grain, and your jar will probably look like it’s filled with cotton strands.

It should be noted that the mycelium will begin to grow *after a few days*, but that doesn’t mean that all of the grains inside the jar have already been colonized by then.

You need to wait at least ten days before using the contents of the canning jars to inoculate any type of substrate.

Within that ten-day period, make sure that you shake the jar at least once every few days so that the fungal mycelium will be able to penetrate the deeper areas of the grain deposit. This will ensure that every grain in the jar will become active and usable later on.

Phase Three – Increasing the Grain Spawn Supply

The third phase of mushroom cultivation is multiplying the grain spawn. The stuff that you produce in the last phase is often tagged as G1 because they are literally phase one grain spawn.

You will be able to multiply your grain spawn by using the mycelium-covered grain spawn from your G1 canning jars. Each G1 canning jar can inoculate up to ten separate jars with rye grains.

Of course, you would still have to sterilize the canning jars and rye grains using the steps that I have outlined before. Follow each step *exactly*, so you are able to accomplish the goals of this phase more quickly. The resulting grain spawn from the second batch of canning jars should be marked with G2.

Each succeeding generation of grain spawn helps bring more generations of grain spawn to life. Deterioration is noted from the third generation onward if the grain spawn is created from previously created grain spawn (not pure mycelium culture).

Each jar from the second batch can in turn be used to inoculate ten more jars filled with sterilized rye grains. It should be noted, though, that when you reach the third generation of grain spawns, some slight contamination is common.

Fruiting bodies, or mushrooms, can be created directly from the first- and second-generation grain spawn. If you open a G1 or G2 jar, mushrooms most likely emerge in the coming weeks.

Phase Four – Bulk Inoculation

The final stage of the cultivation process is the bulk inoculation. Grain spawn derived from pure mycelium culture can be stored for months, but that doesn't mean that grain spawn has the exact same qualities as pure culture.

When grain spawn is ready, it has to be used within a maximum period of 14 days. The quicker you use the grain spawn to inoculate the actual substrate, the better off you will be.

The grain spawn will not "die" if left unused; however, the contents of your canning jars will eventually transform into a hard mass that will be impossible to use. Fungus grows in leaps and bounds every single day, so time is of the essence.

What kind of substrate should you use for mushrooms?

One of the most common substrates is wood chips. Where can you get wood chips?

If you live in a town where there are lots of trees near roads, you can be sure that road maintenance crews will eventually cut down trees to ensure the safe passage of cars. You can use the chopped wood for your own mushroom farm! You can also visit a local sawmill and ask how you can obtain waste wood chips.

Note that not all wood chips are "fair game" when it comes to cultivating mushrooms. Ideally, you should get chips from hardwood trees. Examples of hardwood trees are:

- Red alder
- Green ash
- White ash
- Quaking aspen
- American beech

- American basswood
- Paper birch
- River birch
- Yellow birch
- Maple boxelder
- Butternut
- Black cherry
- Black cottonwood
- Eastern cottonwood
- Flowering dogwood
- American elm
- Rock elm

These are just a few of the hardwood trees found in North America. If you live in another country, and you are interested in using *fresh wood chips* as a mushroom substrate, you may want to visit your local agricultural college, or agricultural department, to learn more about local hardwood trees in your area.

Many mushroom cultivators prefer somewhat softer wood chips from trees like the alder basswood, because fungi find these substrates easier to colonize.

Fungi are parasitic in nature, and they draw nutrients directly from a single source. When you inoculate or introduce grain spawn to bulk substrate, the mycelium from the grain spawn has to "attack," or colonize, the new substrate.

That's the nature of fungi. If the nutrients and anchoring materials are there, it will do its best to re-colonize and survive. If softer wood chips are not available, do not stress yourself over it. Just acquire any available wood chips from hardwood trees, and you should be fine.

The wood chips can be laid out on the ground (much like a regular garden bed). If you have been able to acquire fresh wood chips, then the chips themselves are clean and do not require any additional treatment.

If your wood chips are somewhat dry from being stored for a period of time, get a garden hose and spray the wood chips to speed up the colonization of the substrate.

Dry environments are the main enemy of fungi. Each cubic yard of fresh wood chips would require *at the very least* eight quarts of active grain spawn. Some mushroom cultivators use more, some use less. Eight appears to be the industry average, which is why I'm suggesting that you use eight quarts.

You can use more, but from experience this amount is usually all right as long as the area of the substrate is not too expansive. If you want to inoculate a larger area, you will of course have to use more grain spawn. That's why it is so important to have a clear idea of how big your production will be at the outset, because this idea will help guide you from the first step of the whole mushroom cultivation process. If you have a clear idea of how much mushroom farming you want to do, you will be able to create the right number of pure cultures in the first step, which in turn will influence how many G1 and G2 jars you will be able to produce.

How can you inoculate something as loose and dry as wood chips?

The first thing that you should do is pour the contents of your jars into a large plastic bag. Make sure that plastic bag is big enough so you can *shake* the contents later on.

You must shake the bag before the inoculation to ensure that any rye grains that have fused together are broken apart. When you are ready to inoculate the wood chips, grab a big rake, and pour the contents of the bag carefully over the substrate. Pour a little over one area first and integrate the grain spawn by running a rake over the wood chips.

The whole process of inoculation is really like cooking or baking. You will be mixing the grain spawn to make sure that it is evenly distributed throughout the media. Take your time in spreading the rye grain so that most of the wooden chips in the bed receive some of the active grain spawn.

If the conditions are right, and the wood chips are moist or fresh enough, a large volume of mycelium will begin to emerge in the substrate. It should be noted that mushrooms may or may not erupt immediately after the inoculation.

The reason for this is that mushrooms typically emerge when subtle changes in the *weather* suddenly occur. So, at this point you have to wait for these normal changes to take place before you can expect any mushrooms to sprout from the wood chips. If you see mycelium growing well on the wood chips, don't stress yourself out, even if there are no mushrooms yet.

Chances are, you did everything correctly, and the fungi are just waiting for a natural signal from the environment before it starts creating fruiting bodies. Sometimes, the waiting period can be as long as a few months. Do not get disheartened. In the mean time you can create more pure cultures and G1 batches so you can start on other bulk substrates.

This way, you will be able to harvest mushrooms every few weeks, or every few months. A single substrate bed left on its own can produce mushrooms for long periods of time. The fungi are self-sufficient after you've done your part in growing and inoculating it.

If the idea of working with wood chips is not appealing, you can use another popular type of substrate: pasteurized straw. Straw from plants like wheat can be used as a substrate for mushroom farming. Pasteurization can be accomplished by wrapping large bunches of straw with clean cloth and submerging the same in hot water.

The water bath for the straw substrate should have a minimum temperature of 164.8 degrees Fahrenheit (73.7 degrees Celsius) but should not exceed 185 degrees Fahrenheit (85 degrees Celsius). The straw is bathed in hot water to kill bacteria and fungi that may have stuck to the strands when it was acquired.

After the straw is cooked, it is lifted and drained. Take note that any straw used as bulk substrate should be no more than four inches long. The straw

substrate should then be combined with the G1/G2/G3 grain spawns and placed in durable plastic bags. Close off the bags with a simple twist wire.

Within 14 to 21 days, the inoculated straw will be colonized completely by the mycelium. When the bag becomes white with mycelium and hyphae strands, it's time to cut slits in the plastic bag to allow more air to penetrate the substrate.

Mushrooms, or fruiting bodies, will emerge from the slits that you have created on the plastic bags. At this stage you have to store the mushroom bags in a location that has a relatively stable temperature and good humidity levels. Daily misting is also a must. A regular spray bottle is all you will need to keep the humidity level up for the mushrooms.

How to Harvest Mushrooms

If your mushrooms look good enough to eat, they are probably ready for harvesting.

Harvesting mushrooms is extremely easy. Here are some basic guidelines when it comes to picking mushrooms that are ready for the harvest:

If your mushrooms have relatively slender stems, you can pick them with your hands. Twist the mushroom at the base of the stem and pull upward (not sideways).

This ensures that the stem will be snapped away neatly, and the mycelium network underneath will not be damaged too much. This method is also a neater approach to harvesting trust me, you won't drop mushrooms to the ground accidentally if you pick them properly.

Avoid pulling out the substrate or any part of the fungi that rests below the substrate. Target the visible end point of the stem of the mushroom (which can be clearly seen from the surface of the woodchips or plastic casing) and twist off the mushroom from that point.

Avoid creating holes on the surface of the substrate. Random stumps should also be avoided.

Use a soft brush to remove visible contaminants on the mushrooms you have picked. Do not wash the mushrooms and don't submerge them in water! If you do not have a brush, a piece of clean cloth will do. Gently clean the mushrooms and place them in a paper bag or a basket.

Avoid storing freshly picked mushrooms in plastic bags or worse, Ziploc bags. Mushrooms are always better off if they are stored in a cool and dry place. Woven baskets are also excellent for storing harvested mushrooms.

It should be noted that most mushrooms only need three to seven days to fully mature. If a mushroom looks good enough to be cooked, then it is probably ready for harvesting. Harvest the mushrooms immediately!

If you wait too long, your mushrooms can end up being overly mature, and this might have an impact on the mushroom's appearance, flavor, and ultimately, its marketability. Don't forget to research your market as well.

Is there a market for dried mushrooms?

Are people cooking with fresh mushrooms frequently?

Do people like the idea of combining mushrooms with other vegan ingredients?

These are the basic market-related questions that you have to answer because these questions will ultimately have an impact on your harvesting methods, and your timing, when harvesting mushrooms.

Part 2: Cultivating Oyster Mushrooms

Oyster mushrooms are probably one of the most widely used edible mushrooms in the world. They're packed with nutrients, and are used both in home cooking and in fine dining.

There is a large market for this mushroom in the United States and around the world. It's so good that it's actually worth the time and effort if you decide to farm some at home just for your family's own consumption.

Imagine being able to pluck fresh mushrooms every few months. A single serving of oyster mushrooms can provide 11% of the adult RDA for iron. Iron is extremely important for health and vitality, and iron occurs naturally in oyster mushrooms.

Don't ask me how the fungus actually separates the iron from the substrate but, it's adding an essential micro-nutrient to a very tasty mushroom variety.

The use of oyster mushrooms predates modern cookery. In fact, extant history points to the fact that Chinese medicine men were already using oyster mushrooms as a component in traditional medicaments as far back as three *thousand* years.

In Chinese traditional medicine, oyster mushrooms are noted for their ability to boost the immune system naturally. A boosted immune system is able to fight off infections more quickly. We're talking about both bacterial and viral invasions.

I'm not saying that mushrooms can replace antivirals or antibiotics, but, like probiotics, they can help the body strengthen itself naturally so that over time, it would be better equipped to stave off illness.
Researchers have also discovered that this particular species of mushroom is full of a unique and powerful antioxidant called *ergothioneine,* which is unique to fungus. And the best news of all is that the antioxidant is unaffected by cooking! That means the main health benefit of the mushroom is *not reduced* even when the mushroom is stewed or stir-fried.

Growing oyster mushrooms is not difficult at all. Pure culture, or mycelium, is now being sold commercially and is being produced for the mass market. The mycelium that is sold to mushroom cultivators and enthusiasts are often rigorously inspected before being sold, to ensure that the mycelium is able to thrive when it is used to create grain spawn.

Culturing is preferred in mushroom cultivation because it provides consistent results. Stored culture is also preferred to tissue obtained from free spores, because you can be sure that the target fungal strain will appear on the agar media. Fungal inoculum and cultures are mass-produced nowadays, but that doesn't mean that the quality of these inoculums is dubious.

Industry-grade inoculums are prepared by professionals who have devoted themselves to the development of mushroom culture. Even the containers used to transport are aseptic, and have been designed to ensure proper air exchange between the culture/inoculum and the environment.

Producing Oyster Mushrooms in Bags

Oyster mushrooms (*Pleurotus ostreatus)* can be cultivated in plastic bags. Mushroom cultivators in North America often use the following materials to raise oyster mushrooms:

- Wheat straw
- Cottonseed hulls

It is also possible to get good results when you combine these two substrates. Any wheat straw that is being used to raise oyster mushrooms must be cut into two six centimeter pieces.

Some farmers prefer pure cottonseed hulls because they don't have to mill or cut the hulls. You can try to experiment with pure straw or pure hulls. If that doesn't work for you, you can try combining the different substrates. The combined substrate should have the following components and percentages:

- 75% hulls

- 24% straw (milled/cut)
- 1% limestone (ground)

Why are mushroom farmers opting for this combination?

Well, it has been determined that this particular mixture actually holds in moisture more efficiently than pure straw or pure hulls.

As you may already know, moisture is extremely important to fungi. In fact, fungi will cease to grow if its environment becomes too hot and too dry. This is also the reason why homes that are poorly ventilated will often have large deposits of molds and other fungi.

Fungi rely solely on pure chance when it comes to growing in the wild. Millions of fungal spores are in the air, and yet, only a handful of these spores will ever find a good substrate to grow on.

Mushroom farmers have to be mindful of all the different factors that affect the propagation of mushrooms, because if one factor is less than acceptable, mushrooms will not grow abundantly.

Substrate and Spawn Preparation

If you are planning to cultivate a large volume of mushrooms, you may want to borrow or invest in a small mixer.

It has been found that substrates that have been combined using a mechanical mixer tend to absorb up to 69% more water than otherwise. Large mushroom farms also make use of *steam* to loosen and add even more moisture to the substrate.

The introduction of steam also sterilizes/pasteurizes the substrate, which makes it even more ideal for mushroom culture because the steam kills bacteria and even fungal mycelium, upon contact. Once the mixed substrate has been mixed and steamed, it's time to cool it down.

You can just allow the substrate to cool on its own, *or* you can use filtered air to help lower the temperature. Big mushroom farms make use of HEPA filters to ensure that the air being blown against the substrate is free from contaminants (such as wild fungus spores).

1-½ hours should be enough to cool down a considerable amount of substrate, provided that you are using a strong air blower. If you are not using any filtered air, the cooling process will take longer to complete.

In the previous section, I shared with you the average weight/measurement of inoculum used for wood chip substrates.

In the context of farming oyster mushrooms, it has been found that mushroom yields come much more quickly if the weight of the inoculum used is at least 5% of the substrate's total weight *when it is still wet after the sterilization.*

So that means you have to weigh a sample of your substrate in order to approximate the combined weight of a batch of substrate *before* it is

completely dry. Of course, if this approach doesn't work, you can always add *more* inoculum. There is no such thing as "too much" inoculum when it comes to mushroom farming.

Generally, the more inoculum you add to the substrate, the better the results you get. The downside to this, of course, is the fact that you will have to purchase or produce more grain spawn from pure culture. This takes time and effort, but if you are really serious about producing mushrooms for personal consumption, or for the local market, then it is labor well spent.

It should be noted, though, that grain spawn produced using the traditional method tends to deteriorate further down the line. So it is possible that G1, G2, and G3 batches will produce good mushrooms but the succeeding batches of grain spawn will produce less than favorable results.

Batches of grain spawn that are produced with *pure culture* on agar will almost always produce better mushrooms than grain spawns that have just been derived from older grain spawn. If there is deterioration in the quality of the oyster mushroom mycelium, you have two options.

1. The first option is to culture new grain spawn from pure mycelium culture.
2. Your second option is purchase commercial grain spawn.

Either way, you will get good results.

Both options offer a unique advantage to the mushroom farmer. If you continue culturing mycelium on your own, you will eventually chance upon a strain that is robust.

You can multiply this strain and store them for future use. The more you venture into creating your own pure mycelium culture, the more experience you gain and the easier it gets. You will also be able to amass a line of "champion" mycelium cultures that you can reproduce again and again, season after season.

If you decide to turn to commercial inoculum/grain spawn, the advantage there is that you won't have to worry too much about spawn vigor or contamination. All you have to do is buy the inoculum and add the inoculum to the substrate that you have prepared.

There are also other factors that influence the growth of oyster mushrooms:

Nutrient density of the grain spawn may initially influence the growth of the first batch of mycelium in the new substrate.

The number of available grain spawns also influences the speed at which fungi is able to colonize and break down the available substrate. Remember: fungi have to break down substrate *first* before it can colonize its new home.

If the substrate is generally resistant to fungi, then the progress of the fungi will be generally slow. That's why ideal substrates and methods should always be used, because mushroom farmers want to see results faster.

The more available spawn there is, the better the coverage of the substrate. Coverage is an important factor because our environment is filled with bacteria, molds and other potential troublemakers.

The substrate you have prepared for your mushrooms may well be the best substrate for other types of molds. If most of the substrate is exposed to viable grain spawn, then competing fungi will not be able to grab hold of the substrate.

We must also take into consideration the presence of small weeds in the substrate. Sure, plants are different from mushrooms and fungi in general, but that doesn't mean that they will not compete with mushrooms for nutrients in the substrate. If weeds and other common garden nuisances appear, then it's up to you to remove them and *keep them off* your bulk substrates.

Recent statistics also show that there is a fixed correlation between the amounts of grain spawns used, and the total production time for each batch

of mushrooms. The trend is quite simple: the higher the volume of grain spawn or inoculum used, the shorter the production time needed.

Inversely, the *lower* the volume of grain spawns used per season, the *longer* the total production time. So, when it comes right down to it, you will not be on the losing side if you decide to invest on a large volume of commercial inoculum.

Normally, wood chips and other natural substrates will provide a sufficient amount of nutrients to the mushrooms. However, since we want the best results in the shortest amount of time, I recommend that you add *dry supplements* to the substrate as well. There are generally two types of dry supplements that mushroom farmers can use: regular and delayed-release.

Examples of dry supplements are feather meal and treated soybean. *However,* it must be noted that adding nutrients to any substrate requires additional work and time, because you have to monitor the temperature of the substrate *after* you have added the nutrients.

Why should you monitor your substrate?

Well, it has been observed that dry supplements often *increase the temperature* of the substrate via chemical reactions.

So if the substrate begins to overheat and the fungi are still not as robust as it should be your fungi can deteriorate quickly. The weight of the dry supplement is also dependent on the weight of the substrate when it is cool and *dry.*

At the time of inoculation, add at least 3% of the total dry weight of the chosen substrate. I f you increase the amount of nutrients to 6%, production time can be shortened by as much as three days.

However, the higher the amount of dry supplement used the higher the need to aerate the substrate, so be ready with your substrate cooling equipment. Air temperature control is so vital to the whole process that you should be

vigilant when it comes to increases and decreases in environmental temperature.

Let's move on to the preparation of the plastic bags which will be the final home of your new mushrooms. Polyethylene is preferred when it comes to mushroom cultivation because this material is durable, and can withstand moisture as well as the addition of dry supplement to the substrate.

Polyethylene bags also maintain their structural integrity, even after slits are made on the surface. If you have a lot of substrate and inoculum, you have the choice of using small polyethylene bags or larger, high capacity bags. Large polyethylene bags can easily hold 30 pounds of inoculated substrate.

Just make sure that you have the space for these larger bags, and the time to regularly monitor them. It is also important that you keep the environmental temperature to 73.4-77 degrees Fahrenheit (22 – 25 degrees Celsius).

This is the ideal temperature range for oyster mushrooms. Any lower than this, and the fungus might not develop fruiting bodies quickly enough. Any higher, and the fungi might deteriorate. After bagging, fruiting bodies are usually harvested 21 to 28 days later.

Growing Oyster Mushrooms in Bottles

If you do not like the idea of managing large bags of substrate hanging from the ceiling, you may want to try a method of growing oyster mushrooms that originated from Japan. Instead of using polyethylene bags, the inoculated substrate is placed in wide-mouthed glass bottles.

When the spawn run has finally been completed, the lids of the bottles are completely removed, and fruiting bodies are allowed to grow upward. Bottles filled with inoculated substrate are often grouped together in metal trays. Up to sixteen bottles can fit in specially designed metal trays.

Now, it is important that you “scratch” the surface of the visible mycelium after the spawn run. When the bottles have turned white from all the mycelium growing inside, about two millimeters of thread mycelium have to be removed from the surface.

This “scratching” will help stimulate *even growth* of fruiting bodies on the exposed mycelium. The mycelium that is being covered by the bottle will

not be able to grow any mushrooms, so you are dependent on the mycelium that is visible when you remove the lid of the bottle.

Here are some additional guidelines for this method of growing oyster mushrooms:

The most inexpensive way to humidify any spawning room is to just spray the substrates manually.

Inoculated bottles must be placed indoors, in a temperature-regulated room. The minimum operating temperature is 61.4 degrees Fahrenheit (16.3 degrees Celsius) while the maximum temperature for this method is just 68 degrees (20 degrees Celsius).

The visible surface of the mycelium (which is also the part of the fungus that comes into contact with air) should never be allowed to dry. To accomplish this the total humidity of the room must never fall below 96%. If you can get the humidity up to 98% that would be best.

How can you increase the total humidity of a room?

The most convenient (not necessarily cheapest) method is to invest in a centralized humidifier. Centralized humidifiers provide consistent results, and you only have to add water every day to keep these machines going. An industrial-grade humidifier can easily run for 18-24 hours nonstop.

The downside to using these machines is you have to pay more for your utilities every month *and* you also have to obtain purified water. Although tap water is fine for the most part. However tap water often contains a significant amount of minerals.

We don't see or taste these extra minerals in our water, but they're there and they can negatively impact your humidifiers.

Powdery residues from these minerals can often manifest and *increased exposure* can also irritate your lungs. So with this in mind it is best to stick to purified water.

If you don't want to buy an expensive, centralized humidifier you can just grab a large spray bottle and spray your mushroom bottles manually. Mushroom growers usually spray their bags/bottles two to three times a day, depending on the general humidity of the locale.

If you live in a dry locale you will need to spray more frequently. If you live in the tropics where humidity is normally 65% to 75% year round, you may only need to spray the bottle two or three times per day to keep the humidity to an ideal level.

What about temperature control?

Well, the basic model used in Japan is quite straightforward. There is no need to purchase additional air blowers *if* you already have air conditioning inside the spawning room. Recirculated air is sufficient to cool down the bottles if ever they do begin to overheat because of the dry supplement that you have added.

Regular fluorescent light is all that is needed by fungi to grow well indoors.

Unlike the plastic bag method of growing mushrooms, the bottle method requires a slightly different approach to the introduction of the grain spawn. In the plastic bag method, the inoculum is added directly to the substrate and is mixed well before the substrate is added to the bag.

In the bottle method, a small hole is created at the very center of the visible substrate and the grain spawn is placed there. The mycelium *will* grow if it is viable, but it needs time to penetrate the rest of the substrate. With this in mind you may have to wait three to four days more before "pinning" or "buttoning" manifests.

The first two to three weeks do not require any kind of artificial lighting. So you can use lighting or not at this point as it won't affect the growth of the fungi.

When the spawn run is complete (the bottles are covered with thread mycelium), the bottles should receive about four hours worth of light on a daily basis.

You don't have to invest in expensive UVB lights (like the ones used for reptile habitats). Bright fluorescent lights are enough to supply the light energy needed by the fungi to grow well. If you want a specific measurement of brightness, the ideal range for fungi is 50 to 300lux only.

Anything below this range might not be helpful. Too much light won't help so try to keep the brightness within this range. If you have a large room you can cycle the total brightness of the entire room so your bulbs won't have to be switched on all the time.

When pinning begins it is important that you check the ventilation of the room to ensure that the spawning room doesn't have too much carbon dioxide. The ideal carbon dioxide level for growing oyster mushrooms is 700 parts per million (PPM). It doesn't take much to improve the oxygen level in a room. Just open a few windows and let air flow in… this works perfectly.

Frequently Asked Questions

Problem: *Mushrooms are tinged with orange and they deteriorate very easily after harvesting.*

Cause: This might be a case of Pseudomonas tolaasii, a common bacterial invader that also targets fungi like A. bisporus. This problem usually occurs when the spawning room does not have good ventilation and the moisture is uncontrollable. Mushrooms need plenty of moisture in order to thrive, but too much can cause bacteria to multiply more quickly.

Increased and unregulated substrate temperature has also been identified as one of the causes of Pseudomonas tolaasii attacks.

If you added some dry supplement to the substrate and the temperature rose to 95 degrees Fahrenheit (35 degrees Celsius) without you knowing it. Then bacteria might begin to multiply uncontrollably because the substrate has the right temperature, moisture content, and nutrients needed by the bacteria to thrive.

If the signs point to a bacterial invasion, the humidity of the room must be lowered to at least 85%, but no more than 80%. A weak bleach solution (about .2% bleach) may also stave off the bacterial growth. Just sprinkle the weak solution on the visible mycelium.

Problem: *There are other kinds of mold and mushrooms growing on the bottles.*

The presence of other species of mushroom signifies the deterioration of existing mycelium and a possible imbalance of many factors that have a direct impact on the growth of the oyster mushrooms.

Cause: This is another common problem that manifests when the substrate becomes too warm (95 degrees Fahrenheit or more) and the mycelium of the

oyster mushroom begins to weaken and deteriorate.

When mycelium begins to deteriorate the whole fungal network is affected and other molds might end up invading the substrate that was meant to house your oyster mushrooms.

In Northern America two mushroom species are notorious for invading the space intended for oyster mushrooms namely ink caps and green mold. Imagine having green mold growing on the bottles that you painstakingly sterilized and inoculated.

Yes, it can be frustrating and the whole ordeal can be quite disheartening. Especially to beginner mushroom growers who have just spent a considerable amount of money preparing the production/spawning room, etc.

Problem: *Insects are eating away at the mushrooms.*

Cause: Insects are one of the most troublesome enemies of the mushroom farmer, because they can decimate and deform the precious fruiting bodies especially during the warmer months of the year. Insects like Sciaridae have been known to feast off the caps of oyster mushrooms.

If the insects come frequently enough you can suffer from significant losses during harvesting season.

The problem with mushrooms is that they are very sensitive to any imbalances in the general chemistry of the air and the substrate. What this means is that it is risky to attempt to get rid of the insects through conventional means (e.g. applying insecticides).

The oyster mushrooms won't die, but you can expect some structural deformations to occur after you have applied insecticides. For example, the caps of the mushrooms during harvest might resemble lopsided cauliflower florets.

If you are into mushroom farming to make a profit, then these mis-shapen mushrooms will probably be rejected by local groceries. No one wants to

sell mushrooms that looked like they were trampled or gnawed. The integration of Bacillus thuringiensis var. israeliensis is touted as an effective means of staving off insects.

The good news is that you won't have to suffer in silence. There are options that can help get rid of the flies without deforming your mushrooms:

Your first option is really prevention. Hygienic practices should always be observed during the entire spawning process. This is usually enough to reduce the occurrence of flies in the spawning room.

Your second option is to place fly traps around your bottles (or even bags). This manual method of removing flies works well.

Your third option is to acquire the bacterial strain Bacillus thuringiensis var. israeliensis. This special bacterial strain should be mixed in along with the grain spawn and substrate. It will multiply and thrive in the medium/substrate and recent statistics show that the integration of this bacterial strain is sufficient to ward off the most common fly pests of the oyster mushroom.

Problem: *The caps of the mushrooms are deformed even if there are no flies or evidence of bacteria.*

Cause: Physical deformities of the mushrooms are caused by a number of different reasons. The most common causes that are not related to insects, fungi, and bacteria are:

- Poor ventilation

- Presence of smoke in the facility

- Foreign chemical vapors (e.g. car exhaust, pesticides)

- High temperature of the substrate (above 95 degrees Fahrenheit)

- Low environmental temperature during the pinning/fruiting period (below 50 degrees Fahrenheit)

- Poor lighting

Problem: *I feel sick after a few months of working near fungus.*

Using a gas mask may help those who are sensitive to fungi spores.

Cause: You are probably sensitive to the millions of spores being released by the oyster mushrooms. There is no way to prevent the mushrooms from releasing spores. What you can prevent is spore inhalation. Wear a gas mask so you can avoid breathing in the spores.

The spores themselves are not really harmful to human health. Flu-like symptoms may be experienced by people who may be sensitive to them.

Part 3: Cultivating Shiitake Mushrooms

Shiitake mushrooms are sought after in many countries around the world (including the United States) for their unique flavor as well as the general health benefits associated with their consumption. Shiitake mushrooms are a good source of the following nutrients:

- Fiber
- Vitamin B6
- Folate
- Selenium
- Niacin
- Pantothenic acid
- Riboflavin
- Manganese
- Zinc
- Copper

As you can see consuming shiitake mushrooms is like taking a vitamin capsule as they naturally contain all the vital nutrients necessary for a fit and healthy body. Shiitake mushrooms are also extremely marketable.

Vegans have no problems consuming mushrooms. People who are looking for low-fat sources of protein also choose mushrooms when preparing meals at home because they are so versatile.

The list goes on… the best part about this is that interest in mushrooms increases year on year as more studies about its benefits become known.

Growing Shiitakes

Unlike oyster mushrooms which can be cultivated in plastic bags and bottles, shiitake mushrooms have a somewhat *specific need* when it comes to the substrate.

These little guys are cultivated not on straw or wood chips but on actual *wooden logs.*

When the leaves of target hardwood trees begin falling off, that is a sign that the logs are ready to be cut down for mushroom cultivation. After sawing the trees the logs are then cut into one meter portions. Timing is of the essence!

When the leaves drop you have to move fast and cut down the trees quickly, because the sugar content of the trees is *highest* during this time of the year. If you cut down trees during the warmer months (e.g. summer) the logs that you get might not be suitable for shiitake cultivation.

During the summer months the sugar level in the tree trunks are low. Also the wood is looser and therefore, the bark (the outermost layer) can fall off more quickly. When the bark of a tree falls off or is stripped off, organisms like bacteria, mold, and other fungi can easily attack the disintegrating wood.

Here is a list of suitable hardwood trees that you may want to watch out for when scouting for potential substrates:

- Hornbeam
- Beech
- Alder
- Poplar
- Aspen
- Cottonwood
- Pecan
- Post oak
- White oak
- Birch

Wood is such a prime area for fungi that it only takes a week (at most) for other fungi to colonize the wood. So the more quickly you can cut down the hardwoods that you are planning to use the better off you will be.

Mushroom culture is more than just inoculating the right substrate. You also have to take into consideration the fact that competitive fungi can ruin your harvest, and if you don't do anything to stop these wild fungi from coming, then your hard work would give you dissatisfying results.

Now that you know when to cut the logs, let's talk about the *size/diameter* of the logs that you will be using. Unfortunately, you can't just cut down any old hardwood tree for your shiitake mushrooms.

You have to find usable hardwoods within the range of 7 cm to 15 cm if you want the best results. You can use logs that are as thick as 25 cm, but if the log's diameter exceeds this measurement, you may have to cut the log in half lengthwise before using it as a shiitake substrate.

Remember: you have to resize the logs before you inject the wood with the shitake inoculum. Before you inject the inoculum you must have accomplished the following:

1. You must have acquired the logs (with the right size) at the right time of the year

2. You must have measured the logs

3. You must have sawed oversized logs

4. You must have already positioned the logs properly at the cultivation site

Inoculating Wooden Logs

Other edible mushrooms like the oyster mushroom thrive well even without the presence of wood. The shiitake mushroom however, will accept no less than a fine hardwood log. So how can you actually inoculate a log that has just been cut down from the forest (or from the side of a road)?

You will need a high-powered drill, but before you start drilling holes, it's best to contact a local supplier of mushroom spawn so you can order your shiitake spawn plugs.

Spawn plugs are preferred to sawdust spawn because, they are much easier to handle and you can easily track how many dowels you've already used when you are preparing the logs.

When you are purchasing inoculum from a supplier it is best to order at least two different mushroom strains to ensure your success in propagating this fungi. It is also important that you order *the right strains*, depending on the climate of your local area.

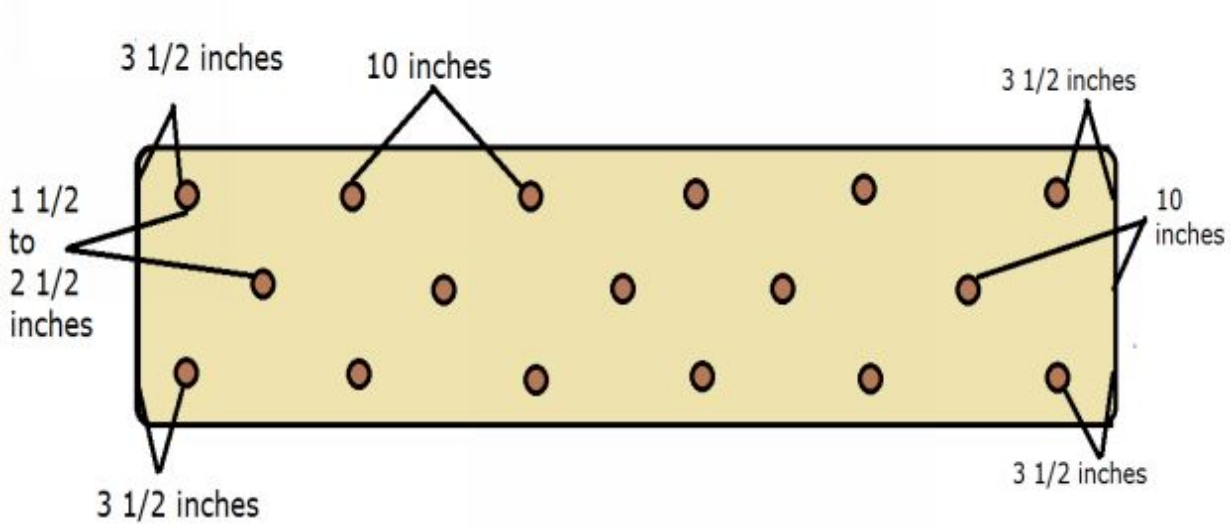
For example, if you live in a chilly region that doesn't get too much sunlight, order a cold-weather mushroom strain that will be able to withstand your area's regular temperature. If you live somewhere warm, it is best to ask for a warm-weather variant so the mushroom will survive high temperatures.

In Japan mushroom growers have been able to develop a third option called the comb inoculum. These wafer-like inoculums have been developed to reduce the total production time needed to grow shiitake mushrooms.

Unless you have a need to reduce the production time by a couple of days. I suggest that you just stick to methods that are relatively easy to accomplish *where you live right now* and not stress over materials and equipment that are hard or expensive to acquire.

Now that you are familiar with the different types of inoculum for shiitake mushrooms, let's move on to the inoculation process. If you are using spawn

plugs/dowels, here are the steps:



Most hardwood plugs are uniform in size so I recommend drilling holes measuring 5/16 inches in diameter with a depth of just 1 inch. You have to find a drill bit that matches this exact measurement (or perhaps a little bigger, if you can't find an exact match) of the spawn plugs, so you can easily insert the plugs in the holes.

Assuming that your log is placed horizontally on the ground, the first hole that you will make should be 3 ½ inches *from the edge* of the log. All succeeding holes in the *first row* should be 10 inches apart; the last hole should be 3 ½ inches from the second edge/end of the log.

In the second row, the first hole should be 10 inches from the edge of the log. All succeeding holes in the second row should also be 10 inches apart; the last hole should be 10 inches from the second end point.

The second row and all other succeeding rows should be 1 ½ to 2 ½ inches away from each other. If you do this correctly, you will be able to create a diamond pattern in the wood. This consistent diamond point pattern is done because shiitake mushrooms grow well if they are placed across the grain of the chosen hardwood log.

Positioning of the hardwood logs is essential too. If you want to position the logs horizontally, you need to stack them neatly in a square fashion. Two

logs should be placed perpendicularly to two other logs so that a neat square can be formed.

Repeat until you have a neat stack. Other shiitake farmers like digging a shallow hole in the ground so the log will stand easily on its own. You can also just lean the logs against a wall or a strong fence.

When the holes are ready, simply insert a plug and hammer in the dowel. You can pound the dowel a little further down the wood if you like. Melted cheese wax can then be applied to protect the newly inoculated wood from insects and wild fungi.

If you wish to use sawdust spawn instead of spawn plugs, here are the steps:

Prepare the log using the outline steps in the previous section. The only difference is the hole should be a little wider this time (3/8 inches) with a depth of 1 ¼ inches.

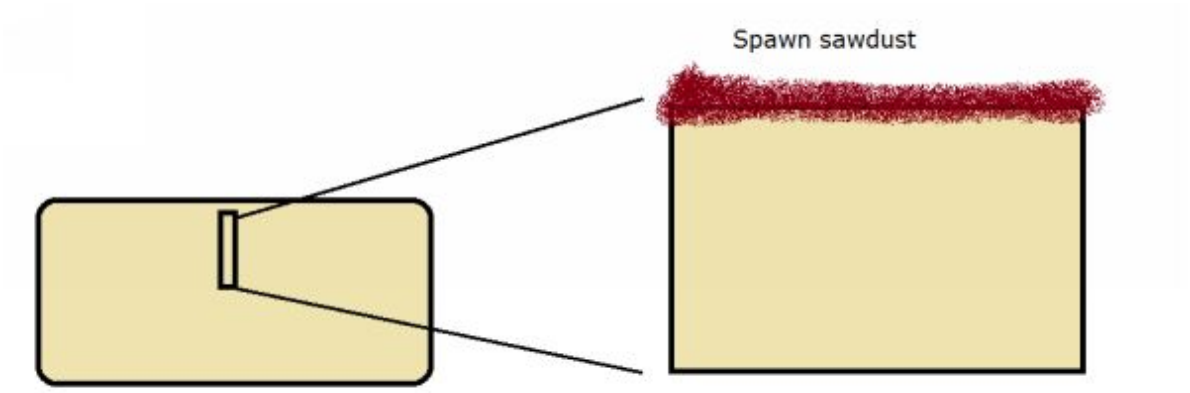
Using a spawn injector/hand injector, apply the spawn sawdust to the newly drilled holes. Cover the inoculated holes with cheese wax.

Now, what should you do if your log is no more than two feet in length? Should you throw it away?

Of course not! There is another method called the wafer technique that you can try.

For this technique, you will need *sawdust spawn* and not your usual spawn plugs. Using a chain saw or any other sawing implement cut off a half inch wooden wafer from the log.

Now get some spawn sawdust and just apply the sawdust directly to the moist end of the wooden wafer. When the edge of the wafer is completely covered with spawn sawdust, simply return the wafer to its original place in the log and re-attach with a nail or two. Make sure that the nails you are using are appropriate for the project. If your nail is too big it might split the wafer and parts of it might fall off.



A tiny wooden wafer is extracted and spawn sawdust is applied to one end of the wooden wafer before it is re-attached to the small log.

Another method that you may want to try if you have a chainsaw handy is the “cut and pack” method. All you have to do is to create shallow cuts in the log. The space created by the cut can be packed directly with spawn sawdust. The packed sawdust can then be protected by paraffin wax.

You can also place some of the spawn sawdust on either end of the log *directly*, as long as you can secure that area with some aluminum foil. If you like the idea of creating shallow wedges in the wood, you can do that too. Pack the sawdust in the space created in the wood, and use regular tape to secure the sawdust for the spawn run.

Shiitake Spawn Run

Hitting inoculated logs loudly with a hammer can actually increase mushroom production!

You should already be familiar with the concept of the spawn run, or simply, the incubation period before your hard work pays off and the fruiting bodies begin to appear on the substrate. It takes a minimum of six months before the fruiting bodies begin to appear on the logs.

Sometimes, the incubation period lasts as long as 18 months, depending on a variety of factors. All you can do is monitor your logs regularly and maintain the ideal conditions for the mushrooms to grow.

Here are some general guidelines and tips that you can apply during this phase of the cultivation:

1. During the spawn run, the logs themselves can be placed in a location that is relatively dry.

2. After the spawning period the logs have to be transferred to a raising area where moisture is more abundant, and has a lower ambient temperature than the spawning area.

The transfer is essential if you want to see results faster, because shiitake mushrooms, like many other fungi, rely on somewhat strange “signals” from the environment before they begin creating fruiting bodies.

3. When it is time to transfer the logs to the raising area, it is helpful if you drop the logs on one end. You can also bang the wood loudly with a hammer.

These actions can actually trigger the formation of fruiting bodies or mushrooms more quickly. No one can actually explain why these actions work, they just do. Fungi are very quirky organisms indeed!

You may modify the arrangement of all the incubated logs in your raising area so that you will find it easier to harvest your mushrooms later on.

4. The spring harvest and fall harvest usually produce exceptionally high yields. However, since mushroom production is at its peak during this time, the price of shiitake mushrooms will also be affected slightly. If you want to grow shitake mushrooms for a winter harvest you definitely have to invest in a greenhouse, with a humidifier and the works.

5. Logs that are in their early incubation phase (this is the first 61 days) should be stacked near each other to slow down the escape of moisture. Moisture is always essential in any mushroom-related endeavor, because it's the lifeblood of fungi. Low moisture might mean death to fungi and subsequently their fruiting bodies (mushrooms).

A delicate balance must be struck in terms of the moisture content of the logs. The ideal moisture content for your logs should be in the range of 35%-45%. How can you determine the moisture of logs?

Well, you have to weigh them before they are inoculated, and after inoculation in the succeeding months.

Sampling should be enough to give you a clue as to how much moisture is left in the wood. If the wood becomes lighter than before then it is probably losing water. If it is heavier, then it is becoming heavy with water (this usually happens when it's humid or rainy).

Too much moisture can also ruin your chances of producing a good harvest, so be wary if the moisture content of your logs if it reaches 60% or more.

What should you do when the moisture content begins to dip?

The most effective way of increasing the moisture content of logs is through nonstop watering.

The watering process should continue for two days. When the watering process is complete, a mechanical air blower should be used to help dry the

surface of the incubated logs. I f you leave the surface of the logs wet, it is quite possible that other species of fungi will latch on to the wood and colonize it as well.

In case you are becoming a little confused about the role of moisture in the whole process, what you really need to produce in your incubating/spawn run area is a stack of logs that have high moisture content inside but are relatively dry outside.

The moisture is needed inside because the fungus is growing inside the log and not outside. The only part of the shiitake fungus that needs to be seen is the fruiting bodies. The rest of the mycelium network will be hidden from view, because the whole mycelium network is busy breaking down the nutrients and raw materials inside the logs.

6. Temperature is very important if you want your mushrooms to arrive on time. On average, shiitake mushrooms are able to grow when the temperature is within the range of 40 degrees to 89.6 degrees Fahrenheit (4 to 32 degrees Celsius). The ideal temperature range that you may want to go for is 71.6 degrees to 77.9 degrees Fahrenheit (22 to 25.5 degrees Celsius).

The former is the temperature range that would encourage the most number of fruiting bodies after the incubation period. I know that it can be hard to maintain the ambient temperature of an outdoor growing facility but, when you are able to provide the right temperature to your mushrooms the returns will be magnificent.

And once the whole structure is already there, you can continue raising the best tasting shiitake mushrooms in your town or city, and you will continue profiting from your efforts (which will become easier and easier with every harvesting season).

7. Placing a canopy over your incubating logs will help maintain the temperature, and will also speed up the incubation process. Sixty percent shade is the ideal minimum. The fungus still needs some sunlight so avoid covering up to seventy percent of the total area.

If you think your first stacking is ineffective in maintaining the moisture of the logs, you can restack them if you want to. Restacking will not affect the spawn at all.

Fruiting Season and the Harvest

After the incubation period, your logs are ready for transfer to the growing area. The growing area, as discussed previously, should be relatively cooler than the incubating area.

The slight drop in temperature will further encourage the growth of fruiting bodies. In many cases, natural changes in the weather will trigger the sudden proliferation of shiitake fruiting bodies.

For example, the environment might become suddenly moist and cool after some heavy rainfall. Fungi, being a primitive organism, has a complex relationship not only with other living organisms but, also with the weather and other complex factors that are present in the environment.

Over millions of years, fungi have learned to adapt and time their reproductive cycles to occur during those times of the year when moisture is plentiful and chances of survival is higher. Your goal as the mushroom cultivator is to create an ideal combination of factors that would trigger the formation of fruiting bodies.

We can't talk to fungi, but we can certainly make a fungus feel that the environment is not hostile and it's time to spread its spores. Mushrooms are technically the reproductive organs of fungi, because they are responsible for the creation of spores.

Now if your area doesn't receive a lot of rainfall you can simulate the arrival of rain by soaking the incubated logs with water. Take note that you need to use *cool water*, so it is best to get some from a river, spring, or any other natural body of water.

The cooling process can be performed in just one day or you can continue soaking the logs for up to three days.

If you want exact details, you'll need to speak to your spawn supplier as the cooling process varies depending on the *strain* or *fungi cultivar* that you

used.

When the actual fruiting begins you can modify the arrangement of your fruiting logs using the X-pattern. The X-pattern is actually quite simple.

Just find a strong fence (or create one in between rows of trees) where you can lean your logs close to each other. Stack the logs left and right so that they are close together and their top sections form an X-like pattern. Harvesting the mushrooms is easy.
Start harvesting any fruiting bodies during the afternoon. When the mushrooms are relatively dry and easy to handle, that's a good time to harvest.

You can either cut the mushrooms off with a small knife (make sure there are no stumps), or you can twist them off with your hands. Either way, you will be able to harvest the coveted shiitake mushrooms. You can collect harvested mushrooms in a clean and dry basket.

Conclusion

Thank you again for downloading this book!

I hope this book was able to give you some insight in to what it takes to start Growing Mushrooms at home.

It may sound like a daunting task to get started, but once you get immersed in the process and you start learning as you do more, that is where this book will become handy.

Finally, if you enjoyed this book, then I'd like to ask you for a huge favour. Please would you be kind enough to leave a review for this book on Amazon?

Even if you took away one piece of information that really helped you, maybe your comments can also help others. It'd be greatly appreciated!

Click here (http://bit.ly/review-growing-mushrroms) to leave a review for this book on Amazon!

Thank you and good luck!