METHODS OF COMMERCIAL CULTIVATION

COMMERCIAL MUSHROOM *Cultivation*

IN THE NORTHEAST UNITED STATES

Visit **www.FungiAlly.com** and
www.CornellMushrooms.org
for additional information and resources.

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INTRODUCTION

This is the second booklet in a series designed to introduce growers to the wide world of specialty mushroom cultivation. While book one focused on an overview of what mushrooms are and the outlook of the industry as a whole, this booklet outlines the considerations to successfully bring mushrooms through the production cycle in a commercial context. Book three focuses on the construction of sound growing spaces, considerations for marketing and sales, as well as grower profiles. If you have not read book one yet we recommend starting there!

As mentioned in the previous guide, mushroom farming offers a wide range of scales and systems to fit within many locations and goals of individual growers. These guides, along with additional information found at our websites (www.FungiAlly.com and www.CornellMushrooms.com) should go a long way to get you started.

In this book, we emphasize the importance of first articulating your mission, goals, and strategies, in order to best define how you want to interact with mushrooms and at what scale. We then walk through the entire cultivation process, offering insights into many of the key considerations for success. Many readers may be familiar with plant-based production systems, and there are several ways they are similar to systems for mushroom production.

Above: Brad Allain owner of Wildwood Mushrooms

Keep in mind that fungi are NOT plants. They have different needs, challenges, and growing patterns.

1. MISSION, GOALS, AND STRATEGIES

The framework of mission, goals, and strategies gives a farm a path from the broad impact down to particular activities of an enterprise. This is a great format to transition from envisioning the world the farm aims to create, to day-to-day operations that will meet those goals. Introducing a mission and goals into a farm can have dramatic results. Understanding the deeper reason why this work is being done while placing clear goals on the table can give motivation, clarity, and empowerment to the farmer and anyone else involved in the farm.

Goals bring the mission into a yearly focus. Annual goals give the farm something to aim for and daily tasks to orient towards. The goals can be financial, personal, event, or production oriented. Strategies further focus what day-to-day operations look like; strategies are the "how", the concrete work being done to achieve the goals and mission. During the development of goals and strategies, don't be afraid to fully explore options and dreams. What would be the best imaginable way to fulfill the goals? Include these in possible strategies. Eventually, you will select two or three strategies for each goal, and now a mission driven business has been created!

MISSION

Having a clear mission attracts customers and employees who share the values expressed in your mission. The mission also acts as a guidepost to refer to when making decisions on the farm. Whenever a choice point arises, this is the statement that is referred to, to clearly decide if the opportunity is in support of or contradiction to the mission. The mission acts as the compass to keep the business headed in the intended direction. Looking at the mission

can be extremely helpful to have connection to why exactly someone started farming and what they were trying to achieve. The mission should be broad and succinct. Mission encapsulates the larger change a business is trying to create in the world.

For example, at Fungi Ally, the mission is to **"Create a world of balance and connection while revealing the power of fungi."** Developing this mission has been a key part of the evolution of Fungi Ally over five years. After four years in commercial mushroom production, Fungi Ally shifted out of primarily producing fresh mushrooms for sale and more heavily into teaching, an efficient method for revealing the power of mushrooms. Providing fresh mushrooms is a good way to fulfill the mission but enabling other people to grow mushrooms and have a deeper relationship through cultivation is an awesome way to fulfill that mission.

To develop your own mission, try to come up with one or two values you would like to bring into the world. Next, add a very broad "how to" statement to bring your values into being.

Common values are things like: community, fun, joy, health, equality, profitability, beauty, creative, and many many others. From this short list a mission could be:

"To create a world of health and equality by producing high quality and affordable specialty mushrooms."

Or

"To create a profitable and fun business by working with mycelium in creative and novel ways."

The mission can feel lofty and ambiguous, so it's hard to know if it is being achieved or not. This is where goals come in. Once a mission is developed, the next step is to lay out annual goals for your enterprise.

GOALS

Goals help bring the mission out of a heady ambiguous realm to very measurable yardsticks, informed by the mission. It is like the process of log inoculation. You place mycelium into a log and hope something is happening for a year, but you don't really know if it works until mushrooms pop out. The goals are like mushrooms, these tangible things that we can definitively say happened or didn't happen. Typically, goals can include anything that is relevant to the mission and feed the business. These might include: profit, revenue, production, events, employees, or whatever feels relevant for that year. It is important for goals to be SMART: Specific, Measurable, Attainable, Relevant and Timely.

Specific means the goal is clearly pointing to one thing in particular. If economic impact was part of the mission, then linking the goal to revenue or profitability is an important differentiation.

Measurable means it can clearly be measured and by the end of the allotted time period it is clear whether or not it was achieved. For example, rather than a goal being "make money," the goal would be to "make $20,000 in profit over the next year".

Attainable refers to the goal being a realistic goal that can be reached based on where you are at now. Don't make a goal that you know you will fail at; in fact it can be nice at the beginning to have some soft balls you know you will hit out of the park.

Relevant goals encourage you to be sure the goal is feeding your mission and is applicable to the business.

Timely refers to a clear delineation of when this goal is going to be achieved. This builds in a time to check in and discern if the goal was achieved, why it was or wasn't, and set new goals.

Creating two or three annual goals and following that up with monthly or even weekly goals is a great way to organize the year. If a goal is to produce $20,000 in profit over the course of a year, monthly goals might be to create $1700 in profit, and weekly goals to generate $400 in profit. This allows an otherwise large goal to become a very measurable weekly check-in. The next step to create a mission-driven business is to develop strategies to help you achieve your goals.

STRATEGY

Strategies are the methods used to achieve the goals. Strategies should be informed by the mission and a full width of possibilities should be explored. There are many different strategies to the goal of generating $20,000 of profit. It could be to sell mushroom products, fresh mushrooms, dried mushrooms, mushroom grow kits, or mushroom spawn. It could be to teach classes on foraging or workshops. Another strategy could be to do consulting or create mushroom extracts, or to secure research and education grants. This is a good time to go beyond any limiting beliefs. Truly explore from the heart what strategies could fulfill the outlined mission and goals and also be exciting to you.

Having a brainstorming session with other trusted people can help when exploring different avenues. Even within the realm of fresh mushroom production there are many different factors to consider, including what markets to sell in, what price to sell for, and what kind of interaction there is with the customer. Mushrooms could be sold for $6/lb to one customer at 300 pounds per week or they could be sold for $12/lb to 150 customers at farmers markets.In both scenarios, the income would be the same but the strategy is extremely different. Just like goals that can be broken down from annual to weekly, strategies can funnel down from a broad annual focus to a narrow weekly focus. If a $400 weekly profit is the goal and a $3 profit can

be expected per pound of mushrooms sold at wholesale rates of $10/lb, you will need to sell around 134 pounds of mushrooms a week. This might mean aiming to grow 150 pounds per week. This now becomes your first weekly strategy!

IN THIS EXAMPLE:

Goal - $400 weekly profit
($3 in profit per pound of mushrooms sold @ $10/lb)

Strategy - Sell 134 lbs per week
(Grow 150 pounds per week)

Now that you have a weekly goal and one strategy to achieve that goal, you will know what to spend time on. With the strategy of selling 134 pounds a week, you can now figure out how many customers you need to get, how many blocks you need to initiate each week; and many other little tasks that can be planned out in accordance with your strategy. If the weekly goal isn't achieved, that is absolutely okay! This isn't a tool designed to create shame or the feeling of being a failure. It is meant to help you explore how to get to where you want to be in your business in a way that feels good. Say you sold 95 pounds in a week. That's a great start! Now look at how your strategy can be improved or changed to hit the goal. Or go back up to the goal and decide the new strategy is to sell 100 pounds of mushrooms at $3/lb profit and do one farm tour where you sell 20 grow kits, adding up to a total of $400 in profit per month. Know that you aren't stuck with one strategy. Be flexible, explore what works for you and the community you live in, and you are bound to be successful.

EXAMPLE 1:

Mission:

Create a world of balance and connection while revealing the power of fungi.

Goal 1: Generate $60,000 of annual revenue through four different channels.

Strategy 1:

Generate $25,000 in annual revenue through 2 different grants

Strategy 2:

Generate $15,000 in annual revenue in online spawn sales

Strategy 3:

Generate $5,000 in annual revenue through consulting

Strategy 4:

Generate $15,000 in annual revenue through grow kit sales

Strategy 4a:

Generate $1250 in monthly revenue through grow kit sales

Strategy 4b:

Generate $291 in weekly revenue through grow kit sales

Strategy 4c:

Sell 15 grow kits weekly at $20/kit

Goal 2: Teach 1,000 people about mushrooms each year

Strategy 1: Run 15 in-person workshops with 40 people each

Strategy 2: Run 10 online courses with 60 people each

EXAMPLE 2:

Mission: Promote a healthy and sustainable community through mushrooms, while generating a steady income.

Goal 1: Generate $26,000 of annual profit.

Strategy 1:

Create $13,000 in profit from mushroom cultivation and sales

Strategy 2:

Generate $13,000 in profit from educational tours and walks

Goal 2: Increase base knowledge of mushrooms by attending classes, seminars and reading books.

Strategy 3: Attend 5 regional forays

Strategy 4: Join the Boston Mycological club and attend 10 walks.

2. SEVEN STAGES OF CULTIVATION

Regardless of the location, species, and method, there are seven main steps to the process of growing mushrooms. Keep in mind that while the steps below are generally true for all methods and species, there is quite a bit of detail depending on the species of mushrooms and growing medium you choose. Here we overview the key points to each step in the process. From this, you can see which strategies emerge for your enterprise that align with your mission and goals.

1. STRAIN SELECTION
2. SUBSTRATE PREPARATION
3. INOCULATAION
4. INCUBATION
5. INITIATION
6. FRUITING
7. HARVEST

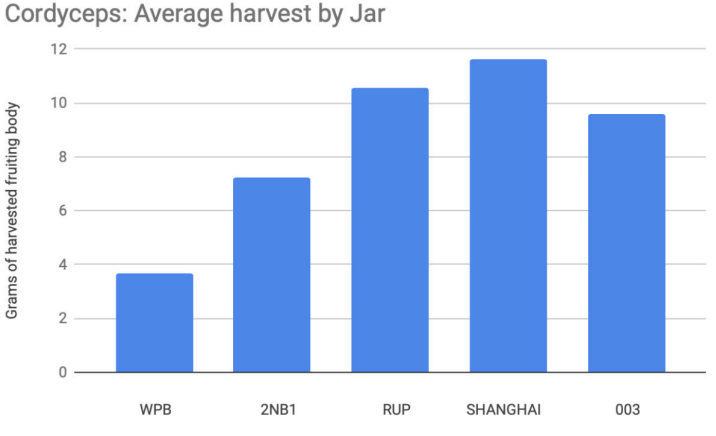
1. STRAIN SELECTION

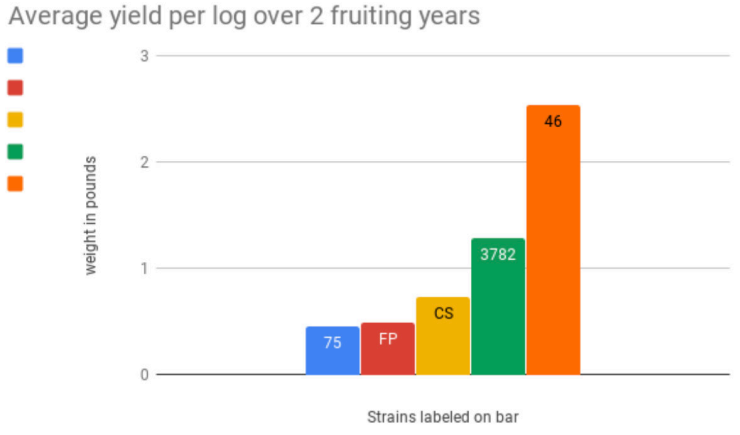
Strain selection is one of the commonly overlooked but extremely important factors to successfully growing mushrooms. The strain is similar to a plant breed. Individual species of mushrooms like Pleurotus ostreatus (commonly known as oyster mushrooms) will have thousands of different strains or expressions of the genetic make- up. This is really easy to illustrate using humans. All humans are in the species Homo sapien but each individual human or "strain" of Homo sapien has a particular set of genetic information that influences all sorts of factors. Factors like size, strength, color, health, longevity, maybe even personality are influenced by the particular strain.

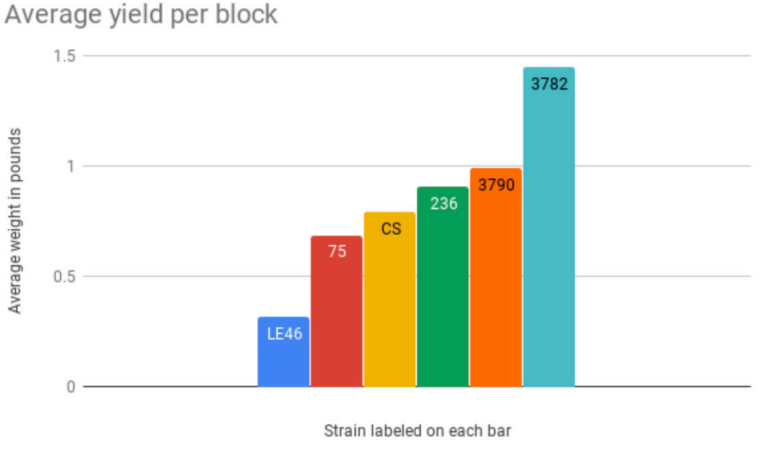
With mushrooms very important factors are influenced by the strain, including:

- **How fast the mycelium grows**
- **Color of the fruiting body**
- **Shelf life of the fruiting body**
- **Fruiting temperature**
- **Size and quantity of fruiting bodies (yield)**

The simple act of selecting the right strain can easily triple yields! Fungi Ally has studied this with cordyceps and shiitake mushrooms, both species showing large variables in the correlation between strain and yield.







In the cordyceps strain trials, yields varied from 3.5 grams per jar to 11.8 grams per jar. The shiitake trials were done on two different substrates: logs and supplemented sawdust blocks. Both had large variables in yield depending on the strain selected. For logs, average yield varied from .5 - 2.3 pounds per log, with strain LE-46 performing the best. On sawdust, yields varied from .3 - 1.4 pounds per block, with strain 3782 performing the best and strain 46 doing the worst. This illustrates how some strains are developed to consume certain substrates. This data also shows that proper strain selection can be the difference between a profitable farm and going out of business.

Any spawn or ready-to-fruit block provider will provide high quality strains selected for maximum performance. If you are producing spawn in-house, its best to trial 4-5 strains side by side to see which one does best. Every couple of months it is good to experiment with a new strain to see if improvements can be made. Growers are constantly trading strains to look for the best combination of strain and substrate. Once the strain is selected, spawn can be ordered or produced.

"Spawn" is intentionally cultivated mycelium from a known species that has been isolated, generally in a sterile lab facility, to ensure it is free of outside contaminants. For most growers, spawn is purchased from a supplier, much like a vegetable grower buying seed from a company. Spawn comes in three common forms: grain, sawdust, and plug.

2. SUBSTRATE PREPARATION

All organic material is broken down by fungi and bacteria. The job of a cultivator is to get the mycelium of the desired edible mushroom established before anything else can take hold. For the highest chance of success, the material or "substrate" needs to be prepared. The word substrate refers to any material that is a food source for mushroom mycelium. The way the substrate is prepared will be guided by the type of substrate and the equipment that is available. Preparation includes ensuring moisture content is optimal and the substrate is clean of contaminants, mixing substrates if desired, and sometimes placing the substrate into a bag. Common substrates

include logs, stumps, woodchips, straw, sawdust, coffee grounds, grain hulls, and other carbon-rich materials. Some species are very particular about the type of substrate used, while others are flexible.

There are several options for substrate preparation depending on the grower's goals, available resources, and infrastructure on the farm or growing site. Each technique carries a set of pros and cons. In general, lower tech methods focus on using low nitrogen, high carbon materials like oyster mushrooms on straw or shiitake on logs. The higher tech methods generally use higher nutrient materials to increase speed of colonization and yield. High tech methods utilize sterilization methods and employ a mix of sawdust or hardwood fuel pellets plus a high nitrogen supplement (grain or seed hulls, coffee grounds etc).

BELOW IS A REVIEW OF SOME COMMON SUBSTRATES AND HOW TO PREPARE THEM:

Logs, wood chips and stumps: On these wood-based substrates, it takes some time for native fungi to get established. It is best to inoculate these substrates within a month of cutting. If temperatures are below freezing, fungi are not active so these materials can be stored until temperatures are consistently in the 40s - 50s at night. There is a common misconception that logs need to sit for two weeks until inoculation, but this is not true. Trees deal with fungal infections primarily by walling off the infection, not through antifungal compounds. Once inoculated, the mycelium takes upwards of 10 days to jump off the spawn into the substrate. At the same time, the wood is losing any ability to wall off an infection. There is no harm in inoculating stumps, logs, or wood chips immediately after harvesting. As long as the tree is healthy, no further preparation is needed. If the ends of the logs have cracks large enough for a dime to be placed into soak the logs for 24 hours before inoculation.

Straw: Straw is a very common substrate for home and beginning commercial growers. It does not produce the best yield and can be difficult to work with as it needs to be chopped for optimal yield. However, there are pre-treated and chopped bags of straw available at local stores and online which can be used successfully. For most farms it is likely more in line with their values to source local substrates and support the local economy. Oyster mushrooms grow very well on straw and are the best species to grow on straw. The straw for oyster cultivation can be treated through fermentation, pasteurization, or a lime soak (covered in detail later in this booklet).

Coffee grounds: Coffee grounds are an interesting substrate to use because they are effectively sterilized when they are used to produce coffee. Two important steps for successfully growing on coffee grounds are: 1) to inoculate the same day as brewing the coffee with them (or resteralize), and 2) to add sawdust to the spent coffee grounds. The nutrients in spent coffee grounds are much more readily available than in wood so ambient bacteria and fungi will start growing within two or three days. Because of this, the grounds should either be inoculated the same day they are used to make coffee or frozen until they can be inoculated. When inoculation does happen, grounds should be mixed with 50% sawdust to increase aeration. The sawdust, which has low nutritional value does not need to be treated.

Supplemented sawdust/wood pellets: This is what most specialty mushroom growers use for a fruiting substrate. Mixing sawdust or wood pellets with wheat bran or soybean hulls helps to achieve a high nutrient and cost effective food source for the mycelium. This requires steam sterilization and a lab for inoculation but produces the highest yields.

Grain: Grain is used as a high nutrient medium for rapid mycelial expansion. It is typically the step after mycelial growth on agar medium. Grain is too expensive and too high in nutrients for bulk substrate fruiting, but can be a good supplement to the sawdust or wood pellet base. It works well to boost yields by inoculating straw with large amounts of grain spawn. Grain also needs to be treated using pressurized steam and inoculated in lab conditions. It is very easy to get contamination on grain, so this is not a beginner substrate.

Agar: There are many different nutrient formulas to make petri plates that are extremely high in nutrients and easy for mycelium to grow on. This is extremely easy to contaminate and is only used in small quantities. For example, an agar substrate is used when storing a mushroom strain or tissue cloning from a mushroom. These must be sterilized and used in a lab-like condition. Sometimes you can get away with doing cloning work in makeshift lab areas, but it is not always successful.

The different substrates are “cleaned” or prepared by several different methods. The table below illustrates common treatment methods and for which substrates they are used.

TREATMENT OPTIONS

Method	Substrate	Materials needed
Fresh	Logs, woodchips, straw at cold temperatures, hot compost.	Source for substrate
Cold Ferment	Straw	Bucket, water, cinder block
Hot Pasteurization	Straw, compost, wood pellets, coffee grounds	Heat source, metal container, cinder block
Lime	Straw, wood pellets	Lime, water, barrel
Atmospheric steam	Supplemented sawdust, straw	Steam source and metal vessel
Pressurized steam	Agar, grain, supplemented sawdust	Pressure canner pot, Autoclave

Each of the treatment methods below has its own set of positive and negative attributes. Growers may want to consider trialing several methods to see what works best for them.

METHOD	PRO	CON
Fresh (Logs, stumps, woodchips, straw)	-no equipment or additional treatment needed -easy to obtain and do -kid friendly	-long incubation time -fruiting yields compared to weight of the substrate are low
Cold Ferment (Straw)	-No energy needed to heat water -Very flexible	-STINKY! -Time from soaking to inoculation varies with seasonal temps -Success is variable
Hot Pasteurization (Straw)	-Reliable process for consistent yields on straw	-Energy (propane, gas, electric) needed to heat water -Lower yields compared to sterilization
Lime (Straw)	-No energy needed to heat water -Moderately reliable -If easy to obtain, lime is cheap ($10 - 15 per 50 lb bag)	-Disposal of high pH water -Can be challenging to acquire specific lime needed depending on location -Lower yields compared to sterilization
Atmospheric steam (Sawdust, wood pellets, grain)	-High-yield substrates -Fast spawn run -Effective for a ariety of mushroom species -Low cost for steam treatment	-Energy intensive -Requires specialized equipment hook-up -Requires lab for inoculations -Higher contamination than pressurized
Pressurized steam (Sawdust, wood pellets, grain, agar)	-Thorough sterilization -High-yield substrates -Fast incubation time -Effective for a variety of species	-Energy intensive -Expensive and infrastructure intensive -Lab required

3. INOCULATION

This step of the process involves bringing the spawn into contact with the substrate to initiate its growth and development. Depending on the substrate, inoculation may entail drilling holes into a log, cutting wedges into a stump, or mixing spawn into individual bags. Outdoor methods can generally be done with little concern for introducing contaminants (mostly molds), while most of the indoor methods require the substrate to be inoculated in a sterile space to avoid contaminating the substrate. There are three factors in this step to consider:

1) WHERE TO INOCULATE

2) INOCULATION RATES

3) SPAWN DISTRIBUTION

Where the process of inoculation happens depends on the nutrient level of the substrate. Low nitrogen, high carbon materials like logs, woodchips, and straw are fine to inoculate outside in the open air. During this form of inoculation it is helpful to be clean, using a clean table and clean hands but sterility is not a concern. Sterility becomes much more critical when using high nitrogen materials like agar, grain, and supplemented sawdust. These are easier for ambient microorganisms to grow on, so require the use of a lab-like setting for inoculations. On a small scale, it is possible to create low budget equipment to mimic a lab setting, but the success rate is lower. A commercial lab would include a separate space for lab use, cleaning and maintaining that space, using HEPA (high efficiency particulate air) filters, and equipment for steam treatment. If inoculations are done in a lab, being mindful of the seven vectors of contamination and implementing proper lab technique is critical.

Inoculation rates are a balance between economics and speed of spawn run. The cultivator is trying to get the desired edible mushroom mycelium established before anything else. The higher the inoculation rate or amount of spawn added to the substrate, the faster the mycelium will grow through the substrate. The substrate likely will not produce a larger amount of mushrooms, so a high inoculation rate means more money spent on spawn per pound of mushrooms. For a new cultivator, using a high inoculation rate can really boost the success rate. As the grower dials in the process of cultivation, they can start to lower the inoculation rate and observe if there is a difference in colonization time.

At Fungi Ally, this sort of trial was conducted on supplemented sawdust. Five pound bags of shiitake spawn were used to inoculate 20 five-pound bags of bulk substrate. These bags colonized in about 8 weeks. Slowly the amount of bags inoculated by the five pound bag of spawn was increased. At 30 five-pound bags of bulk substrate, colonization time was also 8 weeks and contamination rates did not go up. At -40 five-pounds bags, time until colonization was still 8 weeks, and little to no contamination increase was observed. At 50 five-pound bags both colonization time and contamination increased. The sweet spot was using one five-pound bag of spawn for every 200 pounds (40 bags) of substrate. The amount of money spent on spawn was decreased by 50% per pound of mushrooms. Saving .25 cents per pound of mushrooms adds up to a lot when growing 300 pounds per week - almost $4,000 per year!

Spawn distribution also impacts the speed of colonization. Two methods of distribution commonly used are “top spawning” and “through spawning”. Top-spawning is the process of adding the spawn on top of the substrate and letting it grow down. This process is good when inoculating full containers like mason jars that can not be shaken, or for low stakes cultivation. Through-spawning refers to shaking the substrate after inoculation

to distribute the spawn throughout the substrate. This shortens the length of spawn run but adds a small amount of labor. In low tech methods like wood chip beds and straw tubes, through-spawning is achieved by layering the substrate and spawn like lasagna. Alternating between the spawn and substrate allows for faster colonization than putting all the spawn on top. In supplemented sawdust this typically means shaking the substrate after inoculation to distribute the spawn evenly.

The impact of top vs. through-spawning was inadvertently tested at Fungi Ally. One day, the crew was feeling like shaving some time off of the inoculation process. Instead of shaking after inoculating they left the spawn on top for 50% of the bags. Four shelves containing 40 bags each, were filled in the incubation room. The top two shelves were top-spawned, and the bottom two shelves were through-spawned. After 14 days the bottom two through-spawned shelves were fully colonized while the top spawned bags were closer to half colonized. By day 24, the top shelves were also fully colonized. In total it took ten extra days for the same amount of spawn to colonize a five pound bag of substrate. It saved a small amount of labor but was not worth the extra time in incubation. Not only did the top-spawned bags take up more space for a longer amount of time, but the extra time also left more opportunity for contaminants to take hold.

4. INCUBATION

After inoculation, the spawn needs time to grow through the substrate. This process is called incubation. Incubation starts with leap off, which is the moment when the mycelium initially leaps off the spawn onto the new substrate. This typically occurs around four days after inoculation. The mycelium expands through the substrate in a three dimensional sphere. When the mycelium runs into another leap-off point, the mycelium fuse together until the entire substrate becomes one mycelial organism. When the mycelium has grown throughout all of the available food, full colonization has been achieved and they can now be initiated into fruiting.

The rate at which spawn run happens will vary given the density of the substrate and species of mushroom. Oyster, for instance, is faster growing than shiitake. A sawdust-based substrate is much faster than logs. In general incubation time is as follows:

Shiitake logs: 6-18 months

Oyster logs: 4-12 months

Stumps: 24-36 months

Woodchips: 2-12 months (limit incubation time by flipping active bed into new chips)

Oyster on straw: 14-28 days

Oyster on sawdust: 10-20 days

Shiitake on sawdust: 42-84 days

Most specialties on sawdust: 21 days

During incubation, temperature and humidity control are the two primary factors to maintain. CO2 and lighting are not important during this phase. They can be adjusted for the comfort and utility of the humans that work in incubation.

Incubation for outdoor cultivation:

The most important factor during incubation is to ensure the mycelium doesn't dry out. When growing on logs, if the ends begin to show cracking which is big enough to fit a dime into, it is time to soak. Soak the logs for 6-8 hours to get water deep into the log, this should not need to happen more than once per month during the summer months. For wood chip beds, watering right at inoculation and once a week for a month after should be adequate. As long as the bed is located in the shade and chips are 4 inches or deeper, they will maintain high moisture content.

Incubation for indoor cultivation:

During indoor cultivation, incubation can be an important factor in space utilization. By decreasing the amount of time spent in incubation, more bags can be produced in the same amount of space. Playing with variables like temperature, inoculation rate, strain, and substrate can have big impacts on incubation time, allowing more mushrooms to be produced in the same amount of space. Compared to outdoor incubation, water content is not so much an issue as temperature. Since the substrate is contained in a plastic bag or something similar, water does not readily escape. During substrate preparation, the substrate should have received all the necessary water for spawn run. Temperature during incubation should not exceed 80 degrees F and is ideally around 70 degrees F. When using 5- or 10-pound bags of supplemented sawdust, the internal temperature of the bag can be 10-15 degrees F warmer than the outside. If the exterior temperatures are 80 degrees F, the internal core could be 95 degrees F, which is getting warm enough for the mycelium to cook itself and introduce contamination. Exterior temperatures can drop as far down as 50 degrees F, but incubation will take longer. Generally, in a well insulated room, cooling is more important than heating as the mycelium generates heat as it grows.

To ensure the bags do not overheat during incubation it is important to give them space on the shelving. A good general rule is to have a hand's width of spacing between each bag. This allows adequate airflow to pass between each bag. If the bags are touching those spots can easily overheat from the heat generated by the mycelial growth. This causes mycelial dieback and can introduce contaminants.

Shiitake incubation: Shiitake on sawdust blocks are particularly finicky during incubation. They have two extra parts to colonization that most species do not. When full colonization is reached, shiitakes have another 4-5 weeks of incubation. After full colonization, popcorning begins, the block becomes textured and bumpy, and finally around week 5 the block starts to turn brown. Shiitakes should not be moved out of incubation until 75% of the block has turned brown and popcorned. If shiitake blocks are touching each other they will not popcorn and will not produce mushrooms in that spot. It is critical to give shiitake blocks a palm's distance between each bag during incubation.

Shiitakes are much more sensitive to being induced into fruiting by physical shock or temperature swings. If incubating shiitakes, try to minimize temperature swings. If temperatures drop below 55 degrees F after week 4 or 5, the blocks tend to fruit instead of completing popcorning and browning, greatly reducing yields. Physical shock by moving the blocks or rearranging them will also induce early fruiting. Once shiitake are on the shelf, leave them alone for 6-7 weeks until most of the blocks have fully popcorned and turned brown, then move on to fruiting.

5. INITIATION

Initiation is the link between mycelial growth and mushroom formation. This is the time when the substrate is fully colonized and maybe even showing signs of pinning. To initiate fruiting, lowering temperatures and increasing oxygen levels generally encourages mushroom formation. Initiation can be in the form of cold shocking, water shocking or introducing more oxygen by cutting a hole in the bag.

Shocking: Shiitake mushrooms respond very well to shocking. These methods of shocking are not typically used with any other species of mushroom. In log production, this is done by soaking the logs for 24 hours, inundating them with water as if in a strong rainstorm. When using blocks, they typically only need to be soaked for 5-12 hours. Another method of shocking is cold shocking. Refrigerating shiitake blocks for 12-24 hours induces a strong pinset to form. Shiitake blocks are placed in a walk-in cooler for 12 hours and then the plastic bags are stripped off to initiate fruiting.

Cutting: With many other species like lions mane, chestnut, oyster, and king oyster the plastic bags are cut, exposing small areas to the oxygen rich environment, to encourage fruiting. Since the mycelium is all one organism, the energy is sent to the places where fruiting can optimally occur. When cutting the bags, it is good to have the plastic covering the substrate to maintain a high humidity. Different species are cut in different ways.

Oyster, chestnut, pioppino mushrooms:

For initiation of these mushrooms, bags can be cut corner to corner on the broadside of the bag. Bags can then be laid down so the fruiting is on top or the fruiting can happen on the side. Second flushes will happen from the same cut. Be sure when harvesting to remove all mushroom material.

Lion's mane:

For initiation of lion's mane, small v's or x's are cut into the bag. Typically two can be cut on the broad side and one on the compact side of the bag. Mushrooms can form to fistsize from these small holes so be sure to give adequate spacing between cuts. Lion's mane should be side-fruited, as top fruiting can gather water and encourage disease.

King oyster: King oyster requires higher humidity and sometimes scratching or casing for initiation. King bags are usually top fruited. The bags should be cut open at the top, leaving 3-inches of plastic above the substrate. This greatly increases humidity and allows mushroom to develop a long stem as desired.

6. FRUITING

The fruiting process is as much an art as it is a science. Direct observation of the mushrooms and substrate is needed throughout the fruiting process and for each crop. The mushrooms, in their morphology, color, texture, and abundance communicate what it is they need during the fruiting process. Just as there are many processes to grow mushrooms, there are countless ways to fruit mushrooms. Mushrooms can be fruited in a huge range of environments; from simple outdoor fruiting to indoor, highly controlled environments. Indoor fruiting rooms can range from a single shelf all the way up to a tractor trailer. Regardless of how one chooses to fruit mushrooms, there are four primary perimeters to consider:

Temperature: For most species, temperatures in the 60's F are ideal. The highest quality mushrooms with good fruiting speed develop at temperatures in the low 60's F. If a fruiting room was designed perfectly, keeping it around 62-65 degrees F would be ideal. This is a big part of the appeal to fruiting mushrooms in basements and other in-ground areas. By fruiting in a basement, temperatures can be kept in the range of 50-65 F with little to no supplemental heating/cooling. As temperatures decrease, mushrooms tend to fruit slower but have a meatier texture. Once temperatures drop below 50-55 F many species greatly decrease their productivity. As temperatures increase, mushrooms become thinner and go past maturity quickly. As temperatures

rise above 75 F, many species reduce their productivity and become a low quality mushroom. Some growers shift the species being grown based on seasonal temperatures. For example, if growing oyster, shifting from Pleurotus ostreatus (blue or pearl oyster used in fall, winter, and spring) to Pleurotus pulmonarius (phoenix oyster used in summer) can help the business adapt to increasing temperatures in the grow room.

Humidity: Humidity is most critical during the first 4 days after initiation. During these tender days, baby mushroom pins are beginning to fruit. Humidity should be kept above 85%. As time goes on, the mushrooms become more resilient, and are able to withstand lower humidity levels. After about 3 days of pinning it is okay for humidity levels to drop as low as 60%, but ideal conditions mean keeping humidity in the 80% range. Humidity is usually maintained with some sort of commercial humidifier and a humidistat or timer that shuts the equipment on and off.

Lighting: Lighting is the simplest part of creating environmental parameters for healthy mushroom fruiting. If a book can be read comfortably in the fruiting room space, your lighting should be sufficient. The old adage of "keep mushrooms in the dark and feed them shit" doesn't apply with specialty mushrooms. Specialty mushrooms, unlike psilocybe and agaricus (button) need light for proper morphology. There isn't a particular light spectrum that is needed as the mushrooms are not converting light into energy. It seems the mushrooms use light as a measurement of how far to extend their stems. Low-light environments create skinny mushrooms with long stems, similar to plants that are grown in low-light environments. Regular shop lights in the room will work just fine, and LED strip lighting can be used for its energy efficiency.

Oxygen: Keeping the room fresh with oxygen is really what makes the whole art of fruiting mushrooms a dance. Mushrooms, like humans, breathe in oxygen and exhale CO2. When a room is filled with mushrooms and mycelium and sealed up, oxygen starts to run out. Fresh air needs to be brought in to keep CO2 levels below 1000 PPM for most species. Oysters are a little more picky and should be kept below 800 PPM. A general rule is to exchange all the air in the room every five-ten minutes. It is better to blast new air in, exchanging all the air in a minute or two, than have a low level fan on constantly. For example, if a grow room is 10x10x7 that is 700 cubic feet. A fan that is rated at 720 CFM (cubic feet per minute) will bring all new air into the room in one minute. This fan could be hooked to a timer and run for 60 seconds every 7 minutes or so for sufficient air exchange. Most growers install both an intake and exhaust fan and time them to run together. As you bring in fresh air, take consideration for its effect on the humidity and temperature level. For example, bringing in 100 F air into a chamber you want to keep at 65 - 70 F means your cooling system will have to work harder. When CO2 is high, oyster and other mushrooms will form with long stems and little caps.

7. HARVEST

Figure 18 The bounty of all this work! Time to harvest. It is critical to harvest at the right time. With most cap and stem mushrooms, this is as the gills are exposed but the cap margin is still curled under. This is optimal for quality and long term storage of the mushroom. The harvest window can be relatively short, especially in the summer or when temperatures rise above 75 degrees. Mushrooms need to be harvested every day to ensure the highest quality unless fruiting temperatures are below 60 degrees. If this is the case, harvesting some slightly premature mushrooms can allow one day to be skipped before needing to pick again. Mushrooms should be harvested into a container which allows breathing. Plastic with holes in it or cardboard boxes work great. It is very helpful if the containers are rigid to protect the fragile mushrooms inside.

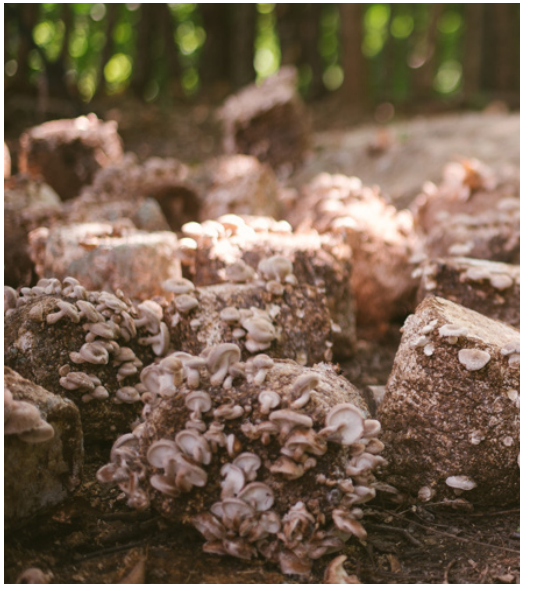
Used bulb crates are a great option for harvesting mushrooms into. If possible, harvesting into the final packaging is a great way to save time and minimize handling of the mushrooms. Mushrooms can be very fragile post harvest, especially oysters.

By minimizing handling, these mushrooms can look way better than any grocery store mushroom. The broken margins on oysters in grocery stores are from excessive handling between the harvester and the consumer. If selling 5 lb cases to restaurants, harvest directly into the cases to sell the highest quality mushrooms. Once the mushrooms are harvested, cool them immediately. Harvested mushrooms should be stored at 34-37 degrees F and will last for about 7 days (if harvested at the right time) before needing to be sold. Shiitake tend to have a better shelf life than oyster or lions mane.

3. CULTIVATING INDORS VS OUTDOORS

OUTDOOR GROWING:
MIMICKING NATURE

In many senses, growing mushrooms outdoors is ideal because the forest (or any shady environment with good humidity and air flow) creates the ideal conditions for fruiting without the need for any climate control on the part of the farmer. Indeed, the forest is where the mushrooms we grow come from, so why not simply grow them there? For centuries, mushroom cultivators have been growing mushrooms on logs in the woods. Ken Mudge professor emeritus at Cornell University researched several species of forest-grown mushrooms for almost 15 years. He explored lion's mane on totems, oyster on logs, wine cap *stropharia* on woodchips, and other minor species. In the end, he, along with most outdoor growers, focused on log-grown shiitake mushrooms, as they proved to have the most economic viability.



The main limit with these methods is that out of the species listed above, only the log-grown shiitake can be grown consistently enough to yield mushrooms on a weekly basis, a necessary part of the supply chain for a farm business. This is due to the unique property that shiitake logs can be soaked or "forced" to fruit by immersing the logs in water for 12-24 hours, which stimulates them to fruit. This method can be utilized to produce mushrooms quite reliably from around the first week in June through the middle to late part of October, at least in the climate of Central New York state. If you are further north, you can expect a shorter season, and further south, a longer one. The other species, while successful, fruit on their own time, and so are not good choices if the goal is to produce consistent yields for markets. What many commercial growers are now finding out is that supplemented sawdust blocks fruit amazingly well, on a reliable schedule during those similar months outdoors. As more businesses offer "ready-to-fruit" blocks for sale this option is becoming more feasible and economical for interested growers. In China, a large majority of commercial production is oriented around this system. Large scale industrial farms produce ready-to-fruit blocks and sell them to small scale farms. The farms are in ideal environments for production and, using minimal infrastructure, seasonally fruit the mushrooms. The mushrooms are primarily dried and then shipped to cities for sale. If this method is translated to the U.S., one key consideration is that the American consumer highly values fresh produce, so small-scale farms should be located close to the consumer.

As compared to indoor systems, the required infrastructure and start-up capital for outdoor mushrooms are low. Over their life cycle outdoor systems use considerably less energy as compared to indoor systems (other than in spawn production and inoculation). Outdoor systems can also support sound forest management practices, since we can directly link the materials (logs, stumps, woodchips, sawdust, etc.) to sustainable practices. However, outdoor mushroom production has its limits. For many growers, the market demands that more species than just shiitake be grown. In addition, those in urban and peri-urban areas may find it difficult to access logs or a shady woodlot. And the realities of a dynamic (and rapidly changing) climate mean that production cycles outdoors are unpredictable than indoors.

INDOORS: CONTROLLED ENVIRONMENT GROWING

Once growers step out of the woods and into a contained space, they can grow year round and have very reliable and precise environmental conditions. Indoor systems offer a degree of buffering from the uncontrollable aspects of weather and climate that are a guarantee with outdoor production. Along with this change, growers have to start concerning themselves with monitoring and maintaining the ideal environment for fruiting.

Indoor farming systems are sometimes referred to as “controlled environment agriculture,” which includes other systems such as hydroponics, aquaponics, and greenhouse production. In contrast to systems used for greens and herbs, mushrooms can be produced in locations with minimal infrastructure and capital to start and sustain production. However, considerations and controls for temperature, humidity, light, and air flow need to be made. These can be addressed through relatively low-cost, off-the-shelf products, or one can get pretty “high tech” quickly if they so desire.

A big advantage of indoor production is that systems can be adapted to work in a wide range of abandoned and underutilized farm infrastructure including barns, outbuildings, high tunnels, and storage facilities. In an urban environment, basements, shipping containers, and warehouse spaces can be easily retrofitted for production. This positions mushroom production to be a system that is accessible to both rural and urban farms, as well as to farmers with limited capital and access to other resources.

Hybrid systems

Farms may choose to focus solely on either outdoor or indoor production, or they may draw upon the benefits of both in a hybrid system. For instance, there are growers who bring shiitake logs indoors to extend the season, and in the same way some will bring blocks outdoors to fruit when the season naturally offers the right conditions. Farms will also sometimes keep shiitake production outdoors, as growing them indoors can occupy valuable space that can be allocated to species such as oysters, which get bugs in them when grown outside.

SYSTEM	SPECIES	PRO	CON
OUTDOOR	Shiitake (logs) Oyster (logs) Lions Mane (logs) Stropharia (beds) Agaricus (beds) Shiitake, lion's mane, chestnut etc... (sawdust)	Utilize woodlot resources and the forest as a growing space Low capital and infrastructure investment Support sustainable forest management	Only shiitake on logs or supplemented sawdust provide consistent (seasonal) yield for market Log moving labor is considerable Access to logs limited for peri-urban and urban locations Not year round
INDOOR	Oyster (straw/ sawdust), Shiitake (sawdust), Lions Mane (sawdust) Chestnut (sawdust) Maitake, reishi, king oyster, etc... (sawdust)	Reliable and larger yields per pound of substrate compared to logs Year-round production potential Precise and reliable environmental conditions	Infrastructure cost upfront can be a barrier More energy intensive - need power, water, heating, cooling, etc. Constant monitoring of temperature, humidity, light, air, etc.

FOUR METHODS OF COMMERCIAL CULTIVATION

This section focuses on describing four different methods of commercial cultivation that are accessible and easy to implement for beginning and diversified farms. Consider which of these methods, or a combination thereof, will work best given your setup, experience, time, and resources.

Shiitake on Logs

Research at Cornell over the past twenty years determined that in addition to the above methods utilizing straw or supplemented sawdust/fuel pellets, there was one outdoor log-based system that could prove profitable. While several species can be grown on logs and stumps, the shiitake offers an advantage from a commercial perspective because the logs can be soaked or "shocked" each week from May/June - October outdoors to create a flush of mushrooms. Data collection has indicated that the materials and labor to inoculate one log is around $4.74, and a good log can yield 4 - 5 lbs over three seasons, grossing anywhere from $40 to $80. There are several nuances and considerations for

this system, and those interested are encouraged to consult the free videos and guidebook, Best Management Practices for Log Grown Shiitake, available at www.CornellMushrooms.org, to learn more.

Oysters on straw

Growing oyster mushrooms on straw is typically the second method of cultivation growers try, after shiitake logs. Oyster mushrooms are most feasible for this method because the mycelium can grow fast and make use of straw as a low-nutrient, high-carbon substrate. Other species can be grown on straw, but with lower levels of success. To create more variety using this method, different types of oysters can be grown (pink, blue, yellow, brown). Straw production has a relatively fast crop cycle of five weeks from inoculation to harvest. These straw logs or "strawsauges" need to be fruited inside (which could include a plastic room in a barn) as bugs will lay larvae in them if they are grown outside.

In addition to straw, growers can experiment with a wide range of materials as a substrate such as stalks from crops, invasive plants, etc. so long as they are harvested and dried before use. Consideration should be taken around the labor efficiency of harvesting, drying, and storing materials. This is why most growers looking for commercial yields choose straw, as it is commonly available and baled in compressed 40lb bales (or larger) that can be stored easily. There are several different ways to treat the straw substrate for mushroom production.

Substrate treatment

The first step in treatment is to shred the straw or material to break down the fibers and expose more surface area. This allows the mycelium to better move through the material as it doesn't have to work as hard to "jump" as far from one fiber to the next. Yields can substantially increase when material is shredded prior to cleaning the substrate and inoculation.

Various tools and methods can be used for shredding, but the easiest is an electric or gas powered shredder that can efficiently process the materials. These units can cost $500 - 1000, but many growers consider this a worthwhile investment in the long term. Materials can also be placed in a drum and shredded with a weed whacker, or laid on the ground on a tarp and run over with a lawn mower. While these methods are less efficient, often

these tools are already on hand or can be acquired for less cost, and they will get the job done. Pre shredded bales of straw can also be found in hardware stores or online.

After shredding the material, there are several options for cleaning the straw. Since straw is a high carbon, low nutrient substrate, it allows for lower intensity treatments that can essentially be done outdoors, without sterile spaces.

TREATMENT METHODS

There are three methods generally recommended for treating straw prior to inoculation. Each has its own considerations for time, cost, and available materials:

Cold Fermentation

While this method is the lowest tech, it's also very stinky! Straw is soaked in water for as little as 5 and as many as 10 days, which essentially cultivates anaerobic bacteria and thus "cleans" the straw for the oysters. The time it takes depends on ambient temperature. During cooler months, expect longer times and during hot months, a much quicker process time. Since all that is needed is water and a container (e.g. a 5 gallon bucket or 55 gallon drum), this is by far the simplest and cheapest method. After soaking, drain the straw and then you are ready to inoculate! Contamination rates for this method are high and this is not recommended for a commercial method of production.

Lime "Pasteurization"

The concept with using lime is to quickly spike the pH of the straw to 12 or 13, killing most competitors, and then inoculate the substrate with oyster mycelium. The key is to use not just any lime, but specifically hydrated lime with a magnesium content (Mg) of LESS THAN 10%. This detail is critical to success. One brand that is available online is Hi-Yield lime, when buying lime always be sure to check the guaranteed analysis to ensure magnesium is below 10%.

Generally, a 50 lb bag costs around $10 - 15 and will be sufficient to "pasteurize" several hundred pounds of straw. A starting point is to add .35 to .5 lbs per gallon of water, but because of the wide range of compositions in lime its necessary to test the solution with pH test strips to determine the proper amount. Soak the straw for 16 - 18 hours in this solution - no longer!

After soaking, drain the straw and then you are ready to inoculate. It's important to consider an appropriate disposal method for the wastewater, which has a high pH and would be considered toxic. Always wear gloves when handling the straw or water, and use an acid-heavy liquid like "pH balance" or "pH down" (available from hydroponic suppliers) to neutralize the water before dumping.

It should be noted that some people report success using wood ash instead of hydrated lime, but you need to add A LOT of this to get the pH to change, and this method may not prove to be commercially viable for operations.

Hot Pasteurization

The most "complex" method is still rather simple, requiring a metal container (a 55 gallon drum is most common) and a heat source (e.g. propane turkey burner, wood fire, or on-demand hot water heater). The goal is to keep the substrate at 140-160 F for at least two hours to pasteurize. The most efficient way to do this is to heat the water and straw to 180 F, shut off the heat source, and put a lid on. This will cool over time but should keep the material in the proper range for 2 hours. You can experiment with timing as some have reported getting clean straw after as little as 1 hour in this manner.

After the straw has been “cooked”, it should be drained and spread out on a cleanable surface (table, clean tarp used only for this purpose, etc), and spread with a clean tool (used only for this purpose) to cool as quickly as possible. Once the straw is able to be handled, or drops below 100 F, it is ready for inoculation. An infrared laser thermometer is helpful to maintain an accurate measure.

Inoculating and Packing

Regardless of the treatment method, the material will next be packed along with oyster spawn into bags or containers. Five gallon buckets with holes drilled in a diamond pattern every 6 - 8” can work well and reduce waste on the farm, but need to be completely and thoroughly cleaned between uses to prevent contamination. 5lb or 10lb filter patch bags or bulk 10” plastic tubing rolls are also commonly used, but do result in waste from the process that must be disposed of.

No matter what container is used, what is most important is that the spawn is well distributed and the material is packed tight. Either grain or sawdust spawn can be used, with the grain offering a little extra nutrition, which can increase growth rates. There are generally two methods of adding spawn; one is to pour a bag and mix evenly, the other is to layer a handful of spawn every 3 - 4” as you pack the container or bag. Growers tend to develop a preference for one over the other, over time.

Check out Fungi Ally’s guidebook on oyster mushroom cultivation for more information on this method.

SUPPLEMENTED SAWDUST BLOCKS - INDOORS

Indoor mushroom production on supplemented sawdust blocks (refered to in this section as “blocks”) is the largest scale method for specialty mushroom production. This method allows for fast cropping cycles with high yields. Indoor block production allows for precise environmental controls and year round production. This method also means that management of the crop intensifies, and costs like rent, infrastructure, and materials increase. If a farm is being developed as a large scale mushroom farm, it makes sense to produce mushrooms using this method.

Indoor fruiting typically means creating a fruiting environment inside of another building or existing structure. Basements of houses, barns, trailers, and warehouses are all viable options for indoor fruiting. One major advantage of indoor fruiting is the flow of production. A farm can be designed to include handling/treatment, lab, incubation, fruiting, storage and shipping areas all in a single flowing building. On a large scale, above 300 pounds per week, this becomes critical; on small scales little inefficiencies can be annoying but won’t make or break the operation.

Creating an indoor fruiting room will be covered in greater detail in the next booklet.

There are three options you can explore to procure sawdust blocks:

1. Create a lab and produce the blocks in-house. This does require a considerable amount of space, up front cost, and training.

2. Purchase the blocks new from another company or local mushroom farm. Take the lab work out of it and start by buying the blocks in. A walk-in cooler and cash flow of about $7,000 is needed for growing about 150 pounds per week.

3. Purchase second-flush blocks from a local mushroom farm, instead of new blocks, which typically cost between $5-7.50; second flush blocks can be sold by the truckload or $1/block. Yields will be much lower and sporadic, but if cash flow is an issue this is a great way to start out growing mushrooms. Additionally, over the course of a year these blocks will turn into incredible soil, so there is both an investment in the mushrooms as well as building organic matter and soil life on the farm.

SUPPLEMENTED SAWDUST BLOCKS -OUTDOORS

Outdoor fruiting on supplemented sawdust blocks is one of the easiest methods to start cultivating mushrooms. Very little infrastructure or space is needed to successfully grow mushrooms outdoors. Several different species including shiitake, lions mane, chestnut, and pioppino can easily be fruited from blocks outside. Since these blocks are ready to fruit, they can be predictably grown outdoors from April-November in northern climates.

Note: It is not recommended to grow oyster mushrooms in this fashion as they get larvae in them when grown outside.

Depending on how the sawdust blocks are procured and what method of shocking is used, the outdoor fruiting area will look a little different. This process can be as easy as putting blocks in the woods and letting them fruit. Find a nice canopy of either deciduous or evergreens and clear away the dead organic material on the ground. Place the blocks directly on the soil with sufficient space between them to allow fruiting and mist 2-3 times per day for the first four days. One issue that can come up is that the mushrooms fruiting at the bottom of the blocks can get a little dirty. To prevent this, simply place pallets down in the woods to lift the blocks out of the soil, so the mushrooms will stay clean even if it rains. A single 4'x4' pallet can hold about fifteen 5lb blocks.

To create the optimal conditions, particularly to increase humidity during the pinning process, install a low tunnel consisting of plastic or metal hoops and greenhouse plastic above the pallets. This allows the moisture to be held in and supports good mushroom pinning. Spraying with a hose once a day for the first 5 days of mushroom formation will create beautiful pin sets. If you

are soaking blocks, particularly 2nd flush blocks, green mold can become abundant if the exterior of the blocks are not allowed to dry before placing the plastic on the low tunnel. After soaking, allow the blocks to dry out for 12-24 hours and then place the plastic over the low tunnel.

With 2nd flush blocks, sometimes it is easier to not manage them, but to let them fruit when the rains decide. Simply spread the blocks out on the forest floor and wait for the rain. If you wanted to try and force the blocks to fruit, you could run a sprinkler for 24 hours after they have sat for 3 weeks. Blocks that are fruiting for the 2nd and 3rd time produce beautiful mushrooms outdoors in the natural environment particularly in April/May and Sept/Oct during the cooler temperatures. Even if indoor block production is the focus, a significant amount of mushrooms can be harvested from "spent" blocks outdoors, if they are visited after heavy rains.

WHAT'S NEXT?

As you develop a concept for your mushroom-growing enterprise, there are several important questions to help you narrow down all the options available. These include:

1. **What is the mission of my farm, and what goals and strategies will help me realize this mission?**
2. **What substrates and methods are best suited for my farm?**
3. **What steps in the process will I produce in-house, versus outsource?**
4. **How much infrastructure do I have/want to invest in building?**
5. **How many hours of labor per week do I want to devote to mushroom growing?**
6. **What are my goals for yields?**

One recommendation is to start small, gain first-hand experience, and try different methods before overcommitting time, energy, and resources to what you think or envision you might want. As with any farming enterprise, the more you can articulate your mission and goals, plan out finances, and develop

markets ahead of time, the better positioned you are for success. Mushrooms offer a unique opportunity to produce a high value crop with growing interest. Buying in ready-to-fruit blocks or growing oyster on straw can allow you to explore and develop a potential market without committing too much money or time.

In the third booklet of this series, the considerations for building out an indoor growing space are discussed, along with the aspects of sales and marketing that are absolutely critical for any enterprise to succeed. Grower profiles will also be outlined as well as the economics of the different methods of cultivation outlined in this guidebook.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