Oyster Mushroom Cultivation

OYSTER MUSHROOM *Cultivation*

In the Northeast United States

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INTRODUCTION

The purpose of this guidebook is to be a resource for people interested in growing oyster mushrooms. The methods used are low tech with minimal cost. Cultivating oyster mushrooms on straw can be done with little up front investment. Oyster cultivation on straw is much faster than cultivation of shiitake or oyster on logs.

Straw cultivation can be done indoors allowing for consistent year round production. This method allows a potential mushroom farmer to gain experience and grow a customer base with minimal investment. Oyster mushroom cultivation on straw may also be a great choice for a diversified vegetable grower looking to add a new item to their CSA or farmers market booth. A typical farm can generate about 60 pounds of mushrooms with 20 hours of work, $80 in materials and some unused space in a barn or other non-insulated building from April to October. (Figure 1)

Table 1:

Cost for growing 60 lbs oyster mushrooms a week

ITEM	AMOUNT	COST
Straw	6 bales	$30
Spawn	10 lbs	$40
Plastic bags	100 ft	$10
Labor	20 hours	$200
Harvest with 100% B.E.	60 lbs @ $10/lb	$600

{Fig.1}

Mushroom cultivation in Northeastern United States, the United States and the world has increased steadily over the last several decades. USDA 2015 data shows an increase of 30% in oyster mushroom production compared to 2014. Amazingly the value of sales increased by 47% in the same time period. The price growers are getting for oyster mushrooms dramatically increased compared to 2014.

The amount of small mushroom farms has exploded over the last decade. This can be attributed to three factors:

1} The increase in information and resources available to potential mushroom growers. 2-5 day mushroom cultivation workshops are being offered around the country sharing the fundamentals of growing mushrooms. Internet forums and Facebook groups help exchange information and new ideas between growers.

2} The local food movement has created a desire for the consumer to know where their food is coming from and who produced it. This movement is encouraging a shift from large national farms to small-medium local and regional mushroom farms.


{Fig.2}

3} America is going beyond the button. More species of mushrooms are being introduced into the American diet. These "specialty" mushrooms, anything not in the Agaricus genus, are being consumed from fine dining to the household. The production and consumption of shiitake mushrooms has soared in the United States in the last 20 years. Oyster, lions mane, pioppino, maitake, king oyster and other specialty mushrooms are experiencing a large increase in production and consumption.

From 2013-2015 production of specialty mushrooms increased by 37%. Mushroom consumers are starting to understand that mushrooms can bring many different flavors and textures to a meal. Oyster mushrooms are particularly well suited for the small to medium mushroom producer. (Figure 2)


{Fig.3}

Oyster mushrooms are native to Northeastern United States. The most common being the species Pleurotus ostreatus.

(Figure 3)

The common name oyster refers to multiple species of mushrooms including but not limited to Pleurotus pulmonarius, Pleurotus salmonostraminus, Pleurotus djamor, Pleurotus citrinopileatus, Pleurotus ostreatus, Hypsizgus ulmarius, and others. These mushrooms cover a range of sizes, colors, and textures. Oyster mushrooms can come in brown, pink, yellow, blue, white or other colors. This allows the small scale grower to offer 4 or 5 different products while only growing oyster mushrooms.

Most of the strains and species of oyster mushrooms can be cultivated using the same systems as this study by simply changing the type of spawn used. Only one method of cultivation needs to be mastered to produce an attractive assortment of products. (Figure 4)

{Fig.4}

A colorful display of oyster mushrooms in a local coop, grocery store, or farmers market attracts customers. Many customers are surprised to learn that the different varieties offered are all oyster mushrooms with different colors. Some growers and spawn producers make creative names for the different oyster strains to personalize their products.

Oyster mushrooms grow extremely fast and aggressively. They require very little in terms of fruiting strategy. They display distinct morphological characteristics when a fruiting condition is not to their liking. This makes oysters suitable to beginners and mushroom farmers with low-tech equipment. Oyster mushroom spawn is readily available as grain or sawdust throughout the United States. This is a valuable resource because the mushroom farmer does not have to dedicate the time and resources necessary to create a sterile lab.


{Fig.5}

Certain strains of oyster mushrooms are abundant fruiters giving a good yield compared to labor input. They fruit in clusters making it easy to harvest and store. Oyster mushrooms tend to be fragile which can create some difficulty in packaging and selling.

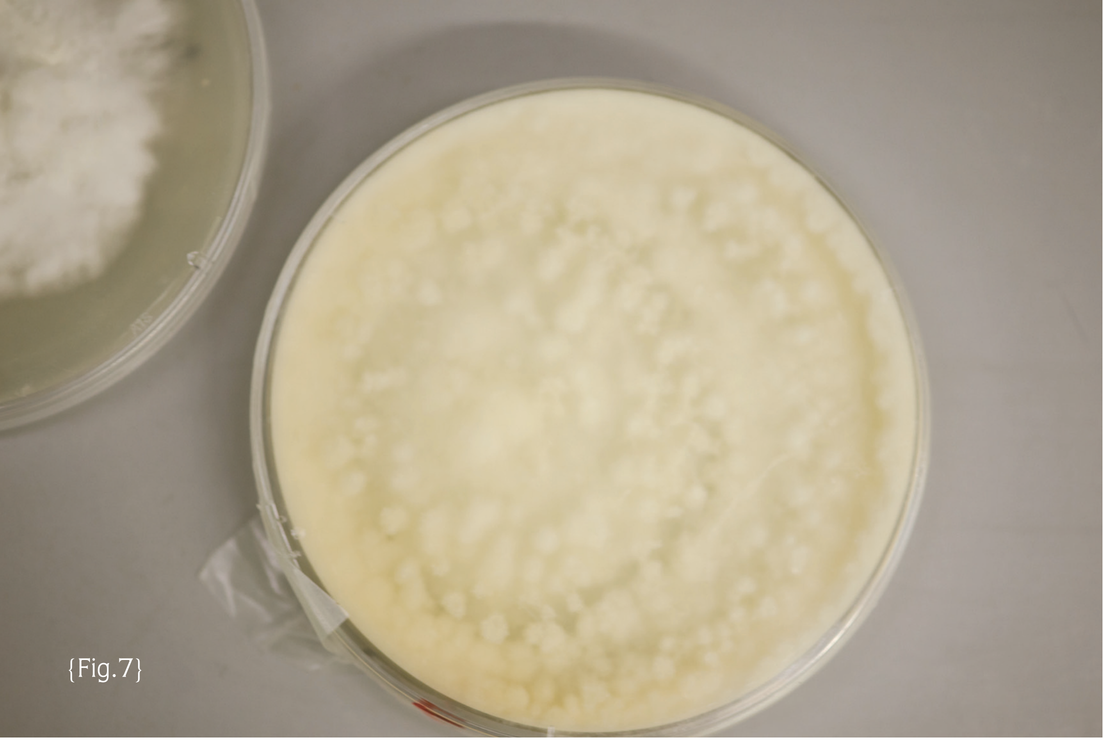
The storability and fragility of oysters can be altered by changing the harvest stage but in general oyster mushroom are more fragile than shiitakes or any of the button mushrooms. This gives an advantage to the local producer, by minimizing the handling of the mushroom. The freshness and quality of locally produced oyster mushrooms can be far superior to what is found in most grocery stores. (Figure 5)

2. THE LIFE CYCLE *of* Oyster Mushrooms

Oyster mushrooms are basidiomycetes, which refers to their means of sexual reproduction. The gills of the oyster mushroom contain basidia, a microscopic structure resembling a tower with a ball on the top. Attached to the basidia are 4 haploid spores that are released at maturity into air currents.These spores germinate mycelium. The mycelium grows through its food source and eventually fruits a mushroom.


{Fig.6}

The mushroom is the fruiting body of the larger fungal organism. The entire point of the mushroom is to provide a platform for sexual reproduction and dissemination of offspring. They are a temple of copulation with an intricate and flamboyant design. Humans, insects, and animals are part of the chain that spreads the spores of the mushroom. Millions of these microscopic spores leave the mushroom. Oyster mushrooms in particular are known for their heavy spore load. This necessitates routine equipment cleaning and use of a mask in the fruiting room. (Figure 6)



{Fig.7}

The mycelium continually exudes enzymes into its growing medium to break down food, create barriers, claim territory, and communicate with its surroundings. The mycelium is readily available physically to attack. The chemical enzymes contain antimicrobial compounds to create a protective barrier around the mycelial network. Fungi digest externally and then absorb the nutrients that have been broken down into their body. The enzymes exuded around the mycelium break down food like lignin and cellulose into simpler building blocks. These sugars are used for continued mycelial growth. It is important to be familiar with mycelium because this is what mushrooms fruit from. Without healthy vibrant mycelium, fruiting bodies will not occur. A mushroom grower first grows mycelium and then needs to create and maintain the right conditions for a mushroom to form. Paying close attention to the health and growth of the mycelium will help to increase yields.

It is also important to understand strain selection. Mycelium with identical DNA and traits can be cultured from a mushroom. From there the mycelium can be expanded by vast quantities. A single petri plate can be the starting point for the production of 1000's of pounds of mushrooms. Culturing allows the grower to select the correct strain for their situation and have predictable results. Consistent genetic information is expressed by culturing the mushroom rather than going through sexual reproduction. Consistency is the key to success. (Figure 7)

{Fig.8}

3. STRAIN & SPAWN

The strain used and spawn source is crucial to the success of any grower. Strains are different individuals of a certain species. Similar to how all people are Homo sapiens but each of us has a unique set of genetic information, which results in a unique expression of traits. In a mushroom the expression of different traits can mean a variety of things important to the cultivator. Morphology, yield, preference and ability to grow on certain substrates, storability, speed of colonization, environmental parameters for fruiting and ability to withstand competing organisms all can be determined by strain. (Figure 8)

Strains can be discovered or developed through two approaches. The first is through finding and isolating a fruiting body in the wild. (Figure 8) These strains need to be trialed and observed to learn their particular expression of different traits. Some of these traits can be observed when the wild mushroom is found. Recording data like the substrate found on, fruiting temperature, region, fruit body shape and color, size of fruiting is very valuable. Strains can also be developed and selected for certain traits through sexual reproduction in a laboratory. Certain desired traits like high yield and wide fruiting temperature can be encouraged through breeding. Strains with a history of use and distinct recorded traits are highly valuable to every grower. A list of recommended strains is below

1) Blue Oyster Amycel 3015- A high yielding oyster mushroom with fast mycelial growth. Fruiting is at a wide range of temperatures about 50-75. Fruiting clusters are large with large caps that range in color from blue to white depending on the temperature grown in and the stage harvested.

2) Blue Oyster Lambert 123- Similar to above, high yielding and fast mycelial growth. Mushrooms are better and yield best when fruited at temperatures between 50-70. Clusters are small and dense which can make packaging easier.

3) Blue Oyster Pearl- A beautiful blue oyster mushroom. Best grown at lower temperatures 50-65. Caps tend to be large, thick when grown at low temperatures, and a beautiful frosty color.

4) Yellow Oyster AM1- A vibrant yellow oyster mushroom. Likes to fruit at higher temperatures between 60-80. Caps are typically small and numerous, large stem mass develops which can be eaten. Yields are medium to high.

{Fig.9}

5) White Oyster Elm A- Not truly an elm oyster in the hysizgus genus rather in the pleurotus genus. A white oyster with aggressive colonization and ability to combat contaminants. Fruiting in temperature ranges of 55-80. Caps are large, it can fruit singularly or in clusters with large individual mushrooms.

6) Pink Oyster VDE-1- Pink to red fruiting bodies, fruiting at temperatures from 60-85. This mushroom cannot survive temperatures below 40. Extremely fast colonization and ability to grow on wide range of substrates. Clusters and cap size are smaller than blue oysters mentioned above. Yield is medium. Storage and shelf life of this mushroom is limited. A good mushroom for farmers market or CSA but not for the wholesale market. (Figure 9)

Spawn type and source has a large impact on yields. The two most common types of spawn used in oyster mushroom cultivation are sawdust and grain spawn. Grain spawn gives one major advantage by supplying a pre colonized Nitrogen source to the substrate. This can help to increase yields of low nitrogen substrates like straw or paper waste. Smaller grains like millet are preferred to larger grains like rye or wheat as they allow for more inoculation points from the same amount of inoculum. One pound of rye spawn may have about 200 particles for the mycelium to leap off from while Millet will have closer to 500. By using millet, a smaller grain, the mycelium will spread more evenly and abundantly through the substrate. Sawdust likewise can be better than larger grains because of the small particle size.

Source of the spawn will also factor in to the success of growth and yield achieved in cultivation. Spawn grown or purchased should be free of any detectable contamination. Smell or sight can be used to detect contamination. A bacterial or yeasty smell to the mycelium indicates spawn that should not be used. If patches of green, pink, red, orange, black, or other colors different than the rest of the mycelium are observed the spawn should not be used. It is tempting to try and remove a small patch of mold on spawn and use it anyways but this will not work. If the mold or bacteria is visible anywhere in the spawn it is present throughout the entire bag. If using aseptic technique, spawn that has been opened outside of the lab should not be used, as airborne contaminants are sure to be present and expanded into the new substrate.

It is important to understand that contamination is not a definitive yes or no answer. Contamination is more like a spectrum than a black and white decision. For this reason it is critical to track yields and weight of the substrate the mushrooms are grown on. From this information biological efficiency can be found. This is the comparison of fresh mushrooms harvested to dry weight inoculated. Through tracking b.e. a grower can tell if they have contamination even if it cannot be visually detected. All of the mycelial growth happens on a microscopic level so it is impossible to know through normal inspection exactly what is happening. Only through the tracking of b.e. will a grower truly know if contamination exists. It is possible for new growers and small growers to grow their own spawn but it will not be the same quality as what is produced in a commercial lab. The level of sterility and effectiveness of the equipment in these labs makes their spawn capable of giving a grower the best yields. If a mushroom grower is going to grow their own spawn they should trial it using the same strain against a commercial spawn producer to see if yield is any different.

4. GROWING OYSTER MUSHROOMS ON STRAW

Oyster mushroom cultivation on straw can be broken into four parts: treatment of the straw, inoculation, incubation, and fruiting. Each step is crucial to the next and affects the overall yield. The step-by-step process of growing oyster mushrooms on straw is outlined below.

1) CHOP STRAW

By chopping the straw the cell walls of the straw are broken making it easier for the oyster mycelium to access the nutrients. Chopping the straw makes the particle size smaller allowing a more compact substrate. A relatively small gap of 1-2 inches between pieces of straw is like the Grand Canyon for mycelium to grow over. It takes wasted energy and time for the mycelium to try and grow over these sorts of gaps. By chopping the straw and firmly packing the bags air pockets can be minimized and yield increased.

2) TREAT STRAW

Using the method which best meets the needs of the grower the straw is prepared for the oyster mycelium. By treating the straw microorganisms are killed and competition for the available nutrients is limited.

3) INOCULATE

Add spawn into the treated straw. This is the material used to introduce the mushroom mycelium to the new substrate.

4) INCUBATE

Incubation should ideally occur at 75 degrees for about 3 weeks depending on the inoculation rate. Bags should be placed with at least a palm distance between them to limit overheating.

5) FRUIT

There are 4 parameters to be aware of when fruiting. They are light, humidity, temperature, and CO2 level. For most oyster mushrooms a well-lit room at 85-90% humidity, 65 degrees, and CO2 below 800 PPM is ideal.

6) HARVEST

Harvesting typically occurs about 5-10 days after the substrate is moved into fruiting conditions. Mushrooms should be harvested before the caps completely flatten out.

4.1 STRAW TREATMENT

1) Hot water pasteurization

Using a 55 gallon drum raised up on cinder blocks and a turkey burner below about 30 gallons of water is brought up to 180 degrees F. Two burlap sacks of straw are then submerged in the barrel and the heat is turned off. A top is placed on top of the barrel and the water is maintained above 145 for two hours. We did not need to turn the heat on after submerging the straw in 180 degree F water. (figure 10)

2) Hydrated lime soak

2-3 burlap sacks of straw are placed in a 55 gallon barrel. 1 Gallon of hydrated lime is mixed with water in a 5 gallon bucket, the lime is dissolved and slowly added to the 55 gallon drum as it is filled with water. The barrel is filled until the straw is completely under water and the solution is at a pH of 12-13. The straw is left to soak for 16 hours. It is critical to use hydrated lime with magnesium content below 10%

3) Cold fermentation

Straw is submerged in a 55 gallon barrel of water for 5-8 days until the smell of fermentation is apparent.

4) Wood ash soak

This method is the same as the hydrated lime soak but instead of using lime wood ashes are used. We found it difficult to bring the pH to the necessary level using wood ashes. Close to 4 gallons of ashes was used for a 55 gallon barrel raising the pH to about 11. The straw was allowed to soak for 16 hours.

In pasteurization, which is the standard for straw treatment, the temperature is raised to kill all of the mesophilic organisms but not reach temperatures to activate the thermophilic organisms. By killing the mesophilic organisms the mushroom mycelium has a clean substrate to grow onto. With the lime soak and wood ash treatment the pH spikes and bursts the cell walls of the microorganisms. Once the straw is drained the pH lowers back to 7 a suitable place for mycelial growth.

{Fig.10}

55 gallon drum raised up on cinder blocks. Water is brought up to 180 degrees F.

To kill the microorganisms using fermentation an anaerobic environment is created by submerging the straw for five days. All aerobic organisms die and the anaerobic ones come alive. Once the straw is removed from the water the anaerobic organisms die as well. All four of these treatments in theory leave the straw free of competing organisms for the mushroom mycelium to grow uninhibited. In practice the lime and heat treatments were much more effective at doing this than the fermentation or wood ash soak. (Figure 11)

{Fig.11}

Efficacy is measured through biological efficiency. This is calculated by dividing the total harvest by the weight of the dry substrate. Each bag used in these trials weighed 10 lbs with a moisture content of about 70%. So each had 3 lbs of dry substrate. To achieve 100% biological efficiency 3 lbs of fresh mushrooms would need to be harvested off of each bag.

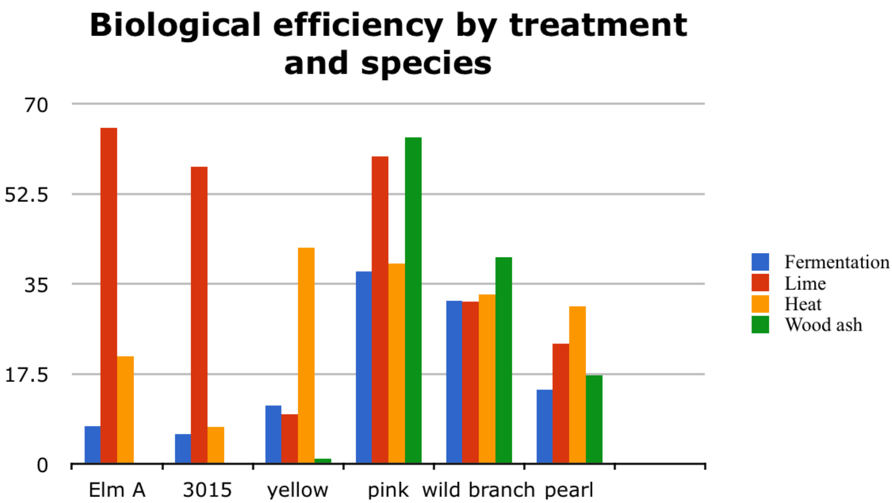
Table 2: **Average biological efficiency by strain**

	FERMENT-ATION	LIME	HEAT	WOOD ASH	
Elm A	7%	65%	21%	0%	23.37890625
3015	6%	58%	7%	0%	17.66927083
Yellow	11%	10%	42%	1%	16.00911458
Pink	37%	60%	39%	63%	49.921875
Wild Branch	32%	32%	33%	40%	34.07552083
Pearl	15%	23%	31%	17%	21.42578125

The highest biological efficiency achieved, 65% used the lime soak and Pleurotus ostreatus Elm A. Of the 8 bags inoculated in total 15 pounds was harvested. If this treatment method and strain were used continuously a grower could likely increase this biological efficiency to 100%. By sticking with a certain strain and method of treatment the grower can fine tune their system to be the perfect set up for that particular mushroom. The average biological efficiency over all the trials is shown in table 3.

Table 3: **Average biological efficiency per treatment**

	Fermentation	Lime	Heat	Wood ash
Average B.E.	18%	41%	29%	20%



There are two major factors that may have influenced the yields of these trials. These numbers include the bags which were contaminated and did not fruit at all. The number of completely contaminated bags was much higher for the fermentation and wood ash treatments compared to lime.

1) Spawn

Spawn was produced in a laboratory that was not customized for the production of mushroom mycelium. There may have been contamination in the grain spawn that would not have allowed for maximum yields. If repeating this study spawn would be grown in a lab designed for growing mushroom mycelium.

2) Fruiting parameters

Fruiting was done in a simple structure created in a tobacco barn. The humidity was controlled by daily watering and a humidistat hooked up to a commercial humidifier. The humidity was typically held in an appropriate range. Temperature was not modified at all. The temperature was typically 5 degrees cooler than outdoor temperature, which meant in the summer grow room temperatures fluctuated between 75-95 degrees. This is extremely hot for most mushrooms to fruit in and was likely part of the reason for poor yields of the yellow oyster.

New growers should source spawn from an outside spawn producer and if they would like to grow in the summer have a system in place for cooling the grow room environment.

4.2 INOCULATION

When growing on straw inoculation does not need to happen in aseptic conditions. The straw does not have high amounts of nutrients readily available so contamination can be prevented by effective treatment and clean inoculation practices. Spawn and all materials needed should be organized close to the inoculation site and readily accessible. A dedicated table and area should be created for inoculation. Steel or plastic tables work best for the inoculation area as they can be cleaned.

{Fig.12}

Wood should not be used for the inoculation site as molds and other fungi can start to grow. All hands should be washed before handling spawn or treated straw and clean clothes should be worn. Inoculate at about 5-15% of the substrate dry weight. It is best to layer the spawn as the plastic bag or bucket is filled with straw. (Figure 12)

Typically two or three handfuls of straw are packed and compressed into a plastic bag and then a small handful of spawn is layered on top. This is continued until the desired bag size is reached. 3-mil 16 inch lay flat poly tubing is a great product for making oyster bags to a customized size.

Once the bags are filled compress heavily to minimize air pockets in the substrate. A zip tie is great to use after compressing fully. Poke holes into the plastic to allow the mycelium to breath. These holes are where the mushrooms will fruit.

4.3 INCUBATION

Incubation is the time when the mushroom mycelium grows out through the straw. Incubation can be done at ambient temperatures or humidity. It is best done indoors but can also be done outside in a barn or shady area. Temperature is one of the most important things to monitor and control during incubation. The substrate is typically 5-10 degrees warmer than the ambient temperature. Ideally the core of the substrate will be around 75-80 degrees. This allows for fast colonization without heat dieback or competing organisms taking over. If the temperature goes higher the mycelium can die and composting organisms can take over. When there are issues of the core of the substrate not colonizing or overheating a smaller bag diameter should be used. When incubating keep space between the bags to allow air circulation around the entire outside surface. This allows for uniform growth and limits the potential for the substrate to overheat. Having fans on the incubating bags can help speed colonization by getting rid of the CO_2 rich air and bringing in fresh oxygen. Incubation usually lasts for 2-4 weeks depending on the inoculation rate. It is good to use several clear bags if using tubing so mycelial growth can be visually inspected.

{Fig.13}

5. FRUITING

The most exciting and visually stimulating part of mushroom cultivation is the fruiting of mushrooms. Once the mycelium reaches full colonization, meaning it has grown over the available substrate, the bag is moved into the fruiting room. A basement where temperatures are stable is the ideal place for a fruiting room. Barns, warehouses, tunnels, greenhouses, and other structures can work well as a fruiting room. Not much space is needed to fruit a large amount of mushrooms. A 10x18 space can easily grow 100 pounds per week. A simple greenhouse like structure can be erected to act as a fruiting room. Use 2x4's to create a frame and staple 6 mil plastic around the inside. This creates a durable, cheap, easy to clean room for growing mushrooms in. Corrugated plastic can also be a great building material to use for the walls of a fruiting room. Once the structure is complete there are four environmental conditions that need to be monitored and controlled. These four conditions are humidity, light, CO2, and temperature. (Figure 13)

Lighting should be similar to lighting found in a house, LED's or fluorescents work well for lighting. A cycle of 18 hours on 6 hours off is perfect for the fruiting of oyster mushrooms. If the lighting is not enough the mushrooms will have long stems and little caps as though they are growing taller looking for the light, similar to what plants do in response to insufficient light. (Figure 14)

{Fig.14}

{Fig.15}

In order to fruit mushrooms must have a moist environment. Humidity should be kept between 80-90% depending on the stage of development. To initiate pinning a higher humidity is necessary close to 90%. During fruit body development a lower humidity can be tolerated. The tricky part of humidification is getting the air to be humid without directly spraying the mushrooms with water. Mushrooms act as sponges sucking up any liquids they touch. If water is consistently sprayed or poured onto them they will turn into a soggy puddle.

There are many different options for misters depending on a growers budget. Several good options with varying cost are home humidifiers, ultrasonic misters, hydrofogger, aquafogger, carbonator pumps and atomizing nozzles, or watering the floor and walls several times a day.

The third environmental condition to be aware of is temperature. Most oyster mushrooms fruit best in the mid 60's. To maximize yields the temperature should be maintained between 55-70 degrees. Some growers try to shift to warm weather-loving strains rather than try to control the temperature but when it is 95 outside mushrooms will not fruit well. When using heating and cooling equipment extra humidification is needed.

Once these three parameters are modified and brought into the ideal range CO2 levels must be monitored. Like people mushrooms breathe in oxygen and emit CO2. If the mushrooms are in an enclosed room it only takes about 10 minutes before the CO2 levels become too high for proper fruiting. To address the build up of CO2 it is recommended that all of the air in the grow room is exchanged at least every 10 minutes. With oysters the more fresh air the better. IF CO2 is too high the mushrooms will have long stems and little caps and at levels above 1200 PPM fruiting can be inhibited. This last part makes controlling the previous three parameters very difficult because all of the air in the fruiting room must be changed out every 10 minutes. A constant conditioning of humidity and temperature is necessary for healthy and productive mushroom fruiting. (Figure 15)

{Fig.16}

6. HARVESTING, PACKAGING, AND SELLING

The last steps to mushroom cultivation are harvesting, storing, and selling the mushrooms. Oyster mushrooms have an extremely fast growth rate. When growing in the 60's or higher mushrooms typically need to be harvested twice a day in the morning and night. The mushrooms should be harvested before the edges of the caps flatten out completely or even flip up. Having a slight roll on the edge of the oyster mushroom will maintain the ideal texture and storability of the mushroom. Harvesting at this stage also limits the amount of spores being released by the mushroom. Harvesting can be done into crates and plastic bins with holes to allow air flow. The mushrooms should not be packed too deep. At most 2 on top of each other as they are extremely fragile.

{Fig.17}

Once the harvest is complete the mushrooms should be stored at 36-38 degrees. To minimize drying a cover or towel should be placed over the mushrooms but some holes in the container or a paper box/bag are needed to allow air exchange. If the mushrooms are stored in a sealed container the water cannot evaporate and will rot within 1-2 days. If properly stored mushrooms can keep for about 10 days. (Figure 16)

When selling mushrooms it is great to have consistent customers that are willing to purchase every week. Restaurants, CSA's, farmers markets, co-ops, grocery stores, and distributors all make for good selling outlets. At Farmers markets it can be good to sell by the pint instead of by the pound. Many consumers find a $5 pint of mushrooms more reasonable than mushrooms for $15/lb. This way a predetermined amount is given to the customer making it faster and easier to sell. In packaging it is vital the mushrooms have ventilation in the package. (Figure 17)

7. GETTING STARTED

The best way to learn about mushroom cultivation is to dive into production. Using the methods outlined in this guidebook mushrooms can be grown from start to finish in one month.

- Mushrooms can transform unused spaces and materials into a profitable food source.

- The by-product of mushroom production is mycelium, which is great for building soils.

- For both the hobbyist and the commercial farmer mushroom cultivation is great to include in a food production system.

- To get started growing mushrooms first pick out a space for fruiting and incubation. Once these sites are selected and prepared begin ordering materials. Below is a list of resources where some of the materials can be found.

- After sourcing the materials follow one of the methods for treatment and inoculate the straw. Mushrooms will be fruiting about 1 month after inoculation. Refine and perfect your system on a small scale and then expand as demand increases.

Straw- local farmer or feed store

Building materials- Hardware store

Spawn- fungially.com, alohaculturebank.com, lambert

Tubing- uline.com/BL_2106/3-Mil-Poly-Tubing

Hydrated lime- fungially.com

Cultures- alohaculturebank.com

Brand of fans for fruiting- canfilters.com, fantech.com

Humidifiers- jaybird-mfg.com, hydrofogger.com, thehouseofhydro.com

For onsite consultations or purchase of ready to fruit blocks contact Willie Crosby at: fungially@gmail.com / www.fungially.com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