

Oyster Mushroom Cultivation

Part II. Oyster Mushrooms

Chapter 6

Growing Houses

MUSHROOM GROWING HOUSES

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In the early days of mushroom growing and in most parts of the world, mushrooms were grown outdoors. Early growers depended on natural environment for the control of mushroom growing conditions. Growers today in the regions with favorable conditions for mushroom growing still grow their mushrooms as if they were wild mushrooms growing in natural situations. But commercial mushroom growers or those who want to produce as many mushrooms as they cannot rely on the natural environment. Most modern mushroom farmers build mushroom growing houses, simple temporary structures, or retrofit an existing structure for mushroom production. Providing good conditions for mushroom growing can lead to a higher yield of mushrooms. A farmer who plans to build a mushroom growing house will have to consider where, with what and how to build it. These topics will be discussed in the following sections.



Figure 1. Outdoor straw mushroom cultivation house
(Photo courtesy of Tricita H. Quimio)



Figure 2. A warehouse-turned mushroom growing-house

Where to Build - Site Selection

The determination of where to build a house is important, especially when building a simple, makeshift structure where the crop yields will be dependant on the environmental conditions of the growing site. The major factors that should be considered when selecting a mushroom production site are described below.

Climate conditions

Although the optimal growing conditions for different mushroom strains vary, mushroom growth is generally favored by warm and humid conditions. In temperate regions, growers who want all-year-round production need to build their growing houses in places that are warmer, sunnier and less windy in the winter. Their counterparts in subtropical regions, however, might want to grow their mushrooms in highland areas that are cooler than other lowland areas during summer. Where environmental conditions are unfavorable for mushroom growth, one could insulate or equip the structure or house with appropriate structures in order to minimize the influences of outside conditions on the microclimate inside the growing room. Polyethylene sheet is one of the most commonly used materials and is often applied to maintain the proper temperature and humidity in the growing house and to shelter thatch houses or makeshift structures from such adverse conditions as heavy rain and strong winds.



Figure 3. Thatch mushroom growing house covered by a plastic sheet, with the floor lined with plastic sheet



Figure 4. Thatch mushroom growing house draped by shade cloth and surrounded by a stone fence



Figure 5. SIP (Structural Insulated Panel) house

Some large-scale commercial growers build well-insulated growing houses, in which all the room conditions including temperature, humidity and CO₂ concentration are controlled automatically. By selecting an ideal mushroom growing site, growers with these types of growing houses can also minimize the significant costs for maintaining desired room conditions.

Access to water

It is widely known that mushrooms are 90% water and are best grown at high humidities around 80-90% R.H. (relative humidity). Growing mushroom requires a great deal of water and ensuring a sustainable water supply, especially during dry spell, is crucial to successful mushroom growing. Growers need a large amount of water when they prepare substrate pasteurize or sterilize the mixed substrate, water the floor to maintain the constant high humidity, water the mushroom bags, or clean the rooms.

Groundwater is widely used, especially for cooling and moistening the room air and for cleaning the room. Selecting a site with a secure access to water source is a must for sustainable mushroom production.

Environmental integrity

Most farmers grow their mushrooms organically, which is one of the main reasons for the increasing popularity of mushrooms. Air-borne pollutants and chemicals could be detrimental to the organic production of mushrooms and the health of farmers as well. Locations near industrial complexes, waste incineration facilities, or sewage treatment plants should be avoided.

Proximity to markets

Mushrooms are highly perishable produce. The price of mushrooms depends on their quality, especially their freshness. Once mushrooms lose their freshness, their marketability and price will drop drastically. To earn the most money available from selling mushrooms, growers need to shorten the time from growing room to store shelf. Selecting the growing site which is not far from mushroom markets is quite helpful to getting more money by selling mushrooms as fresh as possible and reducing the transportation costs. They are also advised to locate potential customers and make contact with supermarket produce buyers, restaurant supply persons and produce wholesalers well before their mushrooms are harvested.

With What and How to Build - Examples

Once the growing site is determined, growers have to consider construction materials and methods with which to build their growing houses. Usual construction materials are those easily available to growers, such as wood poles, steel pipes, bricks, plastic, blankets, leaves, straw, thatch and hay. Some growers can build simple houses with readily available materials. When and where environmental conditions are within acceptable temperature and humidity ranges, a simple, open-style structure built of any available materials will do its job well enough. Other growers will need to construct a closed-style growing house in which room conditions are less affected by outdoor weather conditions. The following examples, ranging from simple to sophisticated, will provide basic ideas about good growing houses and structures.

Simple structures with a roof

The structure shown in Figure 6 is one of the simplest structures for mushroom growing. The open system and the pitched-roof permit good ventilation. However, the control of humidity in this system is not easy when the weather is too dry or too wet. The system requires more water than other closed-style structure because of its greater evaporational water loss.



Figure 6. Steel frame structure with a roof

Simple structures draped by a proper covering

These draped structures are more insulated from outside weather conditions, but are still simple structures. The proper covering provides a good insulation and a high humidity holding capacity for the structure but growers will need to pay a close attention to temperature, ventilation - removal of excess carbon dioxide and supply of oxygen.



Figure 7. Steel structural tubing covered with tarpaulin

Thatch houses



Figure 8. Bamboo woven matting



Figure 9. Bamboo pole rafter and



Figure 10. Thatch house with

leaf-woven roof

shade cloth



Figure 11. Thatch house with insect screening



Figure 12. Rodent/snake barrier in the bottom part
(Photo courtesy of Audrey R.S Mabveni)



Figure 13. Rodent repellent

Thatch houses are the most widely found simple growing houses. Straw, leaves and wood poles are readily available and serve as good construction materials. They are air permeable, thermo-insulating, lightweight and highly pliable. Possible shortcomings, including the easy entry of contaminants, can be improved with proper application and usage of sheltering, insulation, screening, barriers and other materials that could be readily placed on the house.

Pests, diseases and other possible contaminants entering from outside can deteriorate mushroom quality, which translates into a significant drop in income. Some insects spread mushroom diseases. Other pests including snails and rats and their predators like snakes gnaw and eat away mushrooms, substrate bags and even growing houses. Installing proper physical and chemical protective barriers is recommended for these thatch houses. Protective barriers include stone fences (Fig. 4), screening (Fig. 11), plastic sheeting (Fig. 12) and rodent repellent (Fig. 13).

Brick and clay houses



Figure 14. Brick house with a thatch roof and a vent house
(Photo courtesy of Audrey)



Figure 15. Kitchen-turned mushroom growing house
(Photo courtesy of Audrey R.S. Mabveni)

Thatch wears out within a few years. Once it begins to leak, the thatch structure should be renewed. Commercial scale growers might want a more durable growing house that is suitable for all seasons. Clay and earthen bricks are good choices that allow for good insulation, ventilation and prevention from pests. Depending upon material availability and their preferences, growers can choose from a variety of materials for the roof material of their growing house. They are well advised to make ventilation openings in order to ensure frequent air-exchanges.

Greenhouses sheathed in insulation and SIP (Structural Insulated Panel) houses

Sustainable production and a constant supply of harvestable mushrooms are important to successful marketing that can provide growers with a sustainable income. In some parts of the world with adverse climate conditions and

varying seasons, well or totally insulated growing houses are needed for all-season production. Growers in these regions invest a considerable amount of money to set up their growing houses and provide an ideal microclimate for the growth of mushrooms to produce the highest yields possible.

In these closed-style growing houses (Fig. 5, 16, 17), growers need to monitor and control temperature, humidity and CO₂ concentration at all times. They partly or fully depend on sensors and controllers for the growing room control. These sheathed houses are durable. Simple insulation houses (Fig. 16, 17) last 5-7 years and the SIP houses (Fig. 5) can last for more than 15 years.



Figure 16, 17. Green house clad with insulation (glass wool) and roof vents

Why to Build - Functions of a Mushroom Growing House

The major value of a mushroom growing house is to provide favorable conditions for mushrooms and protect them from adverse environmental factors such as harsh weather, pests, pathogens and pollutants. Good mushroom growing houses perform these tasks effectively. Growers might want to have a mushroom growing house well-insulated and at the same time, well-ventilated. Insulation materials mentioned above such as polyethylene, tarpaulin, shade cloth, thatch, clay, glass wool and SIP (Structural Insulated Panel) will work well to provide temperature and humidity control. For easy ventilation however, a pitched-roof and ventilation openings are recommended, especially in closed-style growing houses, as are shown in most figures in this discussion. A pitched-roof requires more money, time and higher technology to set up but provides better drainage, ventilation and temperature control.

Protection against pests and pollutants is also one of the major roles of a mushroom growing house. Among the materials mentioned above, thatch is not good for protection against them. A thatch house should be lined or covered with screening (Fig. 11), plastic or other comparable covering, and surrounded by some barriers or a fence (Fig. 4, 11, 12). Growing houses made of the other materials are free from pests and pollution but some screenings or filters should be installed on the vents to further block access.

The high-tech, insulated panels are an effective means of preventing possible pathogens from entering the room. But fungal and bacterial pathogens can come from the ground. Paving (Fig. 2, 5, 6, 7, 14) or the application of gravels or plastic sheeting (Fig. 3) on the floor is highly recommended for disease prevention, especially where the ground is muddy. Mud on the footwear is a potential



Figure 18. EPS (Expanded Polystyrene) growing house with polyethylene insulation and a bottom barrier along the ground (Photo courtesy of Tricita H. Quimio)

contamination source in mushroom growing houses.

An ideal mushroom growing house does not necessarily need to be a high-tech, high-cost structure with all automatic controls. Some growers ruin their crops even in these state-of-the-art growing houses and other growers reap a rich harvest in humble sheds or garages. The most important consideration is keeping an eye on preventing possible pests and pathogens and understanding the relation between temperature, humidity and air-exchanges. Room conditions including temperature, humidity and air movement are correlated. In a closed environment, when the room temperature rises, relative humidity of air falls. When outside air flows in, temperature and relative humidity of the room air change according to the condition of the outside air. Further, close observation of different growing houses and different practices for room condition control could be helpful to mushroom growers who seek to create optimal growing room conditions for their own operations.