



# Mushroom Growing Blueprint



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# Introduction: Why Mushrooms? Why Shift Your Farm?

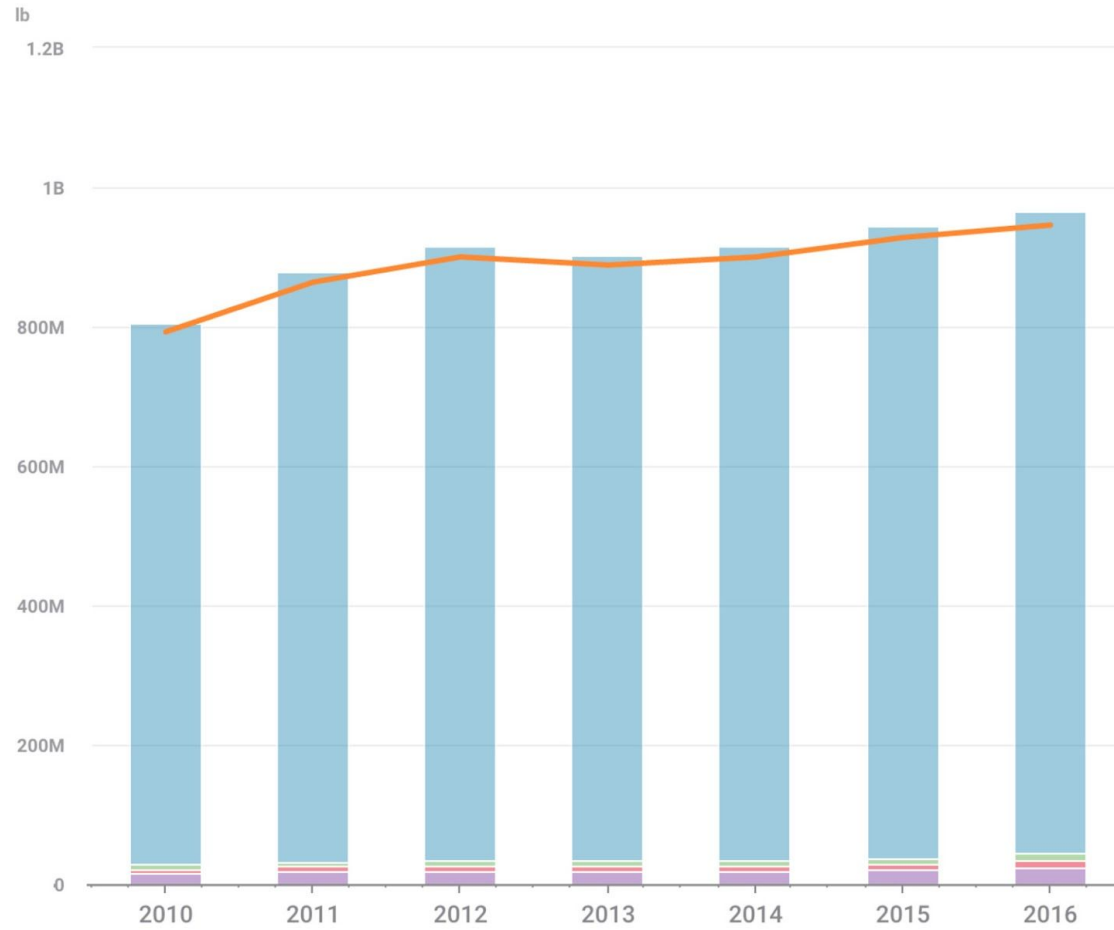
We believe that farmers hold the key to better food, a safer planet, and a sound future. By working with farms, the true source of our food, we have the opportunity to "farm our future." We want to disrupt the food system for the better, while improving social welfare for farmers, ensuring animal welfare and contributing to a positive environmental impact for our future. Part of this shift is encouraging the production of mushrooms.

The top mushroom growing states in the U.S. are currently California and Pennsylvania, but many more states have the potential to grow mushrooms, especially indoors where the climate can be controlled. Statistical data and charts on the growing mushroom market and the place of the U.S. within this market can be found on [Gro Intelligence](#). In sum, because the market has grown exponentially in the last few years, U.S. farmers should consider mushroom production. The button mushroom market in the U.S. is already quite saturated, but the market for species such as portobello, shiitake, oyster, lion's mane and hen of the woods has still room for farmers to enter it.

It is very important to ensure that mushroom production is paired up with a good marketing strategy as this seems to be lacking for many mushroom producers in the US. Ideally, farmers already have a target market and/or customers before they start growing mushrooms.

A great introductory video to mushroom varieties, mushroom growth, market potential and contributions to environmental health can be found on the [YouTube channel of Gruger Family Fungi](#).

# US Mushroom Sales Quantity by Type (2010 - 2016)



Sales Quantity (United States)

—●— Mushrooms ● Agaricus mushrooms ● Oyster mushrooms ● Shiitake mushrooms ● Specialty mushrooms

Data: USDA NASS, Gro Intelligence

[www.gro-intelligence.com](http://www.gro-intelligence.com)

# Mushroom Growing Guides for Oyster and Shiitake

Complete e-books on mushroom production can be found on [Fungi Ally's website](#). The following are excerpts from the e-books.

## **Oyster Mushrooms:**

Growing oyster mushrooms on straw:

- 1) Chop straw to break the cell walls of the straw making it easier for the oyster mycelium to access the nutrients in the straw. By chopping the straw the bags can also be packed quite firmly so that air pockets can be minimized and yield increased.
- 2) Treat the straw to kill microorganisms and reduce competition for the available nutrients.
- 3) Inoculate: Add oyster mushroom spawn into the straw to introduce the mushroom mycelium to the new substrate.
- 4) Incubate at 75 degrees Fahrenheit for about 3 weeks depending on the inoculation rate. Place the bags with at least a palm distance between them to limit overheating.
- 5) Set the ideal parameters for fruiting: well-lit room, 85-90% humidity, 65 degrees Fahrenheit, and CO2 below 800 PPM.
- 6) Harvest about 5-10 days after moving the substrate into fruiting conditions. Harvested before the mushroom caps completely flatten out.

See also the list of Youtube videos on how to [grow oyster mushrooms](#) on a commercial scale.

## **Shiitake Mushrooms:**

- 1) Select strain and formula
- 2) Source, store and mix the substrate
- 3) Bag
- 4) Steam
- 5) Cool
- 6) Inoculate
- 7) Shake
- 8) Incubate
- 9) Brown
- 10) Fruiting
- 11) Harvest

Note on 1) Substrate Formula Selection: The ideal substrate formula is, by dry weight, 79% sawdust, 20% wheat bran, and 1% gypsum.

See also the list of Youtube videos on how to [grow shiitake mushrooms](#) on a commercial scale.

# How to Grow Portobello Mushrooms

## [Outdoor and Indoor growing guides](#)

### Outdoors:

Ensure that daytime temps do not exceed 70 degrees F (21 C) and that night temperatures don't fall below 50 F (10 C).

1. Build a raised bed that is about 8 inches deep and fill it with 5 to 6 inches of well-seasoned compost.
2. Cover the bed with cardboard and black plastic for two weeks. This creates [solar radiation](#), which sterilizes the bed.
3. Meanwhile, order the portobello mushroom spores so they will arrive when the bed is ready.
4. Remove the cardboard and plastic. Sprinkle 1 inch of spores on the compost and lightly mix them in.
5. Let them sit for a few weeks until the mycelium appears on the soil's surface (white webbed film).
6. Apply 1 inch of moist peat moss over the compost and cover with newspaper.
7. Mist twice a day for 10 days or longer if needed.
8. Harvest once the mushrooms have reached your size preference.

### Indoors:

Keep the room between 65-70 degrees F (18-21 C).

1. Fill an 8-inch deep tray with 6 inches of seasoned compost.
2. Sprinkle with spores, mix into the compost and tamp down.

3. Put the tray in the dark until the mycelium starts to grow.
4. Apply 1 inch of moist peat moss over the compost and cover with newspaper.
5. Mist twice a day for 2 weeks.
6. If after 2 weeks little white mushroom heads are peaking out, remove the newspaper. If not, replace the old newspaper with new one and keep misting for 1 week.
7. Remove the newspaper and mist daily.
8. Harvest once the mushrooms have reached your size preference.

See also the list of Youtube videos on how to [grow portobello mushrooms](#) on a commercial scale.

## How to Grow Lion's Mane Mushrooms

Lion's mane grows well on [hardwoods](#) and [supplemented sawdust](#), but they grow slower than shiitake or oyster. They typically fruit in September if grown outside.

### [On logs:](#)

1. Choose the right logs:
  - a. For the short-term: tulip, poplar, or willow.



- b. For the long-term: oak beech, oak chestnut, maple, birch, elm or black walnut.
  - c. Make sure the logs are not too green or invaded by other fungi.
  - d. Freshly felled logs work best, ideally from winter trimming when the tree contains high levels of sugars - carbohydrates for mushrooms to grow.
  - e. Should have a diameter of about 12 inches in diameter; 3-foot logs are easiest to move.
2. Dry the logs for 1 to 3 months until they contain only 40% moisture.
  3. Buy the lion's mane [plug spawn](#) to inoculate the logs. 100 plugs can inoculate 10 logs.
  4. Inoculate:
    - a. Tools needed:
      - i. One pound of sealing wax- cheese grade wax or wax made for mushrooms (NOT regular candle wax = not sterile)
      - ii. A hammer
      - iii. Small paintbrush or turkey baster
      - iv. [Cordless drill](#) with a stop collar
      - v. A double boiler
      - vi. A candy thermometer
    - b. Melt the wax in the double boiler but make sure the temperature doesn't go above 212°F. Too hot and it will kill the spawn.
    - c. Drill rows of holes 1 ¼ inch deep and 8-inches apart. The rows should be 4-inches apart.

- d. Place the spawn plugs. With a hammer gently tap the plugs into the holes.
  - e. With the paintbrush/baster cover the plugs and holes with wax. This keeps off insects and other fungi.
  - f. Soak the logs for 12-24 hours.
5. Stack the logs: Crib style or against a pole with a 45° angle in a shady, moist location with good air circulation.
  6. Fruiting will usually occur 6 months after inoculation, but it could take up to 2 years. If a white fuzz can be seen at the end of the logs, the mushroom mycelium has grown well throughout the log. The logs can bear fruit for about 6 years.

In sawdust (usually indoors):

This is a quicker, more controlled method, but it can be more expensive. Sawdust bags must be in temperatures between 65-75°F for lion's mane to fruit and fruiting occurs about 3 weeks after inoculation.

1. Make the sawdust blocks:
  - a. Combine
    - 5 cups sawdust
    - 1 cup wheat bran (=nutrients)
    - 6 cups warm water
    - 1 cup molasses

Add water until the mixture clumps, and a little bit of excess water drips out if you squeeze it.

- b. Place the mixture in a [grow bag](#) and fold and seal according to instructions.
- c. Sterilize the bags for 2.5 hours in a pressure cooker.
- d. Let the bags cool down.

2. Inoculate:

- a. Add 1 pound of spawn per 5 pounds of sawdust mix. Combine.
- b. Place the bags in a dark area in temperatures between 65-75°F. The block will likely start turning brown and it will take ~ 2 to 3 weeks for the mycelium to grow and spread.
- c. Puncture the bag making 1/4-inch holes. Many holes will encourage many smaller fruits, fewer holes will encourage larger fruits.
- d. Place the block in an area with indirect light and air movement to avoid growth of mold (if too much mold, toss the bags and start again; if too dry, put the bags in a bucket so they retain water or mist them with a spray bottle.).

3. Harvest the mushrooms before they turn pink or brown, usually 4 to 7 days after the pins start popping up. Cut them off close to the base, leaving the spine as intact as possible so more mushrooms can pop.

4. Refrigerate them after harvest up to 2 weeks in the fridge or dry them out: cut into ¼ -inch thick slices and let them dry in a well-ventilated area.

See also the list of Youtube videos on how to [grow lion's mane mushrooms](#) on a commercial scale.

# How to Grow Hen of the Woods Mushrooms (Maitake Mushrooms)

[On logs:](#)

Tools needed:

- One pound of sealing wax- cheese grade wax or wax made for mushrooms  
(NOT regular candle wax = not sterile)
  - A hammer
  - Small paintbrush or turkey baster
  - [Cordless drill](#) with a stop collar
  - A double boiler or skillet
  - A candy thermometer
1. Prepare the log: Obtain a 6-inch wide & 3-feet long seasoned oak log. Submerge it in water for at least 6 hours.
  2. Drill 25 to 30 holes along the log, make sure they are at least 1.5 inches deep.
  3. Inoculate: Use 1-inch long [oak dowels inoculated with Maitake spawns](#) for each hole. With a hammer gently tap the plugs into the holes.

4. Seal: Melt the wax in the double boiler or skillet but make sure the temperature doesn't go above 212°F. Too hot and it will kill the spawn. Apply the wax with the brush or turkey baster on the plugs and holes to seal them. This keeps off insects and other fungi.
5. Store the log for 6 months in a damp area outside suspended above the ground. This keeps off other fungi. Water the log every 2 weeks to keep it moist.
6. Shocking: When the mushroom pins begin to grow, soak the log in ice water for 24 hours to shock the spawn into growth. Fruiting will begin.
7. Harvest when the mushrooms have reached the desired size. It is recommended to wait at least 6 weeks before regrowing the clusters.

See also the list of Youtube videos on how to [grow hen of the woods mushrooms](#) on a commercial scale.

## How to Store Mushrooms

Ideally, they are grown close to the place where they are processed or eaten straight, since they only last really fresh for 24 hours and chilled 3-4 days, due to their high water content. Freezing mushrooms only makes sense if they will be used in sauces or alike afterward because they turn "mushy" after defrosting.

The more companies using mushrooms for meat alternatives, nutritional supplements or bioplastics are emerging, the more need there will be to grow mushrooms close to the processing facilities in various U.S. states.

# Uses of Mushrooms

Mushrooms have applications in both niche and mass markets. Mushrooms are mostly used in the food industry, but due to the need to replace petroleum-based products, the bioplastics and textile industries are exploring mushroom-based materials as alternatives.

## Food and nutrition:

- Eat as is
- Canned mushrooms
- Soups
- Sauces
- Dried mushrooms
- [Meat and fish replacements](#)
- [Medicines and micronutrients](#) (due to mushroom's [anticancer and anti-inflammatory properties](#))

## Other uses:

- [Bioplastics](#)
- Fertilizers
- Rewild lands using local mushroom species

# Market Potential

According to the USDA National Agricultural Statistics Service Information (NASS), in the U.S., the sales for commercially grown specialty mushrooms in 2016 were \$92.6 million, up from \$73 million from the previous season.

Usually, how the mushrooms were grown dictates the price. There is still a lot more research needed in the space of mushroom growth and commercialization, and there are not a lot of experts in this field, yet. However, with a growing world population, an increase in animal product alternatives, plastic alternatives, and more natural medicines, we can expect more demand for mushrooms and more funding for mushroom farms. As more farmers start growing mushrooms though, knowledge will be passed on from farmers to farmers and ideally, mushroom farmers will also be hired as consultants for new mushroom farms. Additionally, as more university professors and students are conducting research on mushrooms, collaborative work and research projects between universities and mushroom farms might arise.

## **Market potential for a few mushroom species according to [Meati Foods](#):**

### Portobello Mushrooms:

Not a saturated market in the US, yet. Export to Taiwan, Mexico, Japan,

### Shiitake Mushrooms:

Not a saturated market in the US, yet. Just starting to take off.

#### Oyster Mushrooms:

Though China also grows them, there might be quality control and contaminated substrate issues with mushrooms produced in China, so the U.S. and Canada would have an advantage if they start growing them in more controlled, hygienic environments.

#### Lion's Mane Mushrooms:

Lion's mane can be used as a seafood substitute.

## **Financial Considerations**

According to Carelton Gruger from [Gruger Family Fungi](#), building a 1 to 2-acre mushroom farm requires a high capital investment and return on investment can be up to 3 years, especially for portobello and shiitake mushrooms, which are both very labor- and technology-intensive. Buying the spawn can be very expensive, so it is ideal to buy it locally and/or hire someone who is trained in setting up mushroom farms and sterilization, and laboratory techniques, at least for the first few weeks.



## Experts on Mushrooms and Supportive Farm Affiliates

1. [Ecovative](#) - use of mycelium to create fibers in vegan meats and fish.
2. [Gruger Family Fungi](#)
3. [Fungi Ally](#)
4. [Meati Foods](#)

It is highly recommended to bring in mushroom experts to build a mushroom farm and grow mushrooms.

## Courses and Workshops

1. [Fungi Ally](#) 6-week online course. \$20 discount using the code
2. [Fungi Ally](#) workshops and other free events in different parts of the U.S.

