

Producing Shiitake

The Fancy Forest Mushroom



Introduction

Farming of exotic mushrooms offers another opportunity to add to farm cash flow or supplemental income. It is also popular among home gardeners and organic farmers.

Shiitake (pronounced she ta key) is the most popular of the exotics, although oyster mushrooms of the *Pleurotus* genus could be grown similarly. Shiitake mushrooms are also called Chinese mushrooms or Black Forest mushrooms. Name choices are important in marketing and should be selected carefully.

This mushroom, as well as other exotics, is a specialty product normally targeted for upscale markets. Health food stores, oriental restaurants, supermarkets, specialty food processors, farmers' markets and upscale restaurants are all market targets for both fresh and dried specialty mushrooms.

Shiitake have almost doubled the fresh shelf life of button mushrooms. They can easily be dried or frozen to a high quality product that will hold a long time. Most oriental recipes call for the dried form, which becomes stronger in flavor. About 7 pounds of fresh mushrooms yield 1 pound of dry.

Cooked shiitakes have a strong, wild mushroom flavor. The mushrooms are generally not eaten raw because few like the sharp, garlic-like flavor. Their most popular use is as flavoring for gravy, stews, stuffing, dips and spreads.

Substrate

Shiitake mushrooms are produced on healthy, freshly cut hardwood logs. Once inoculated, logs will produce for about four years. Shiitake may also be produced on blocks of hardwood sawdust and grain blend. For large-scale production, this is the way to go. This sawdust substrate, although faster in production, demands more skills and more specialized equipment. It also has a greater risk of failure. Some growers buy already inoculated sawdust logs. A good fruiting facility is necessary. Log-style production is

much more popular and best suited to home gardens and smaller producers with 5,000 or fewer logs.

Home production should be on logs. Twenty to 40 should be sufficient for gardeners. Shiitake production is a front end, labor-intensive type of farming. An attractive feature is that underused tree species and second growth hardwoods can be used.

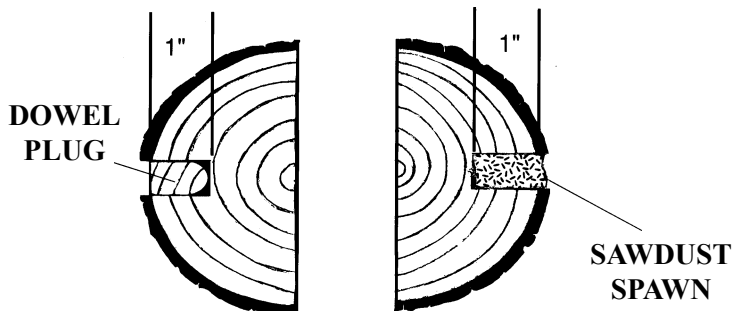
Shiitake farming may be part of a woodland management package. Sweetgum and oaks of the white oak group do well in Louisiana, but tulip poplar and blackgum should work also. Other species can produce but won't hold up well.

Cut your trees while dormant to retain the bark. This is generally from November through January or February. End cutting when buds begin to swell. Substrate logs are 3 to 4 feet long and 3 to 6 inches in diameter. They are handled gently so that the bark remains undamaged. Bark retention is essential to shiitake production.

Spawn

Spawn or seeding material is purchased from a spawnmaker. Several strains are available and can be matched to the wood and season of expected fruiting. Some spawn strains are best suited for sawdust culture. A wide-ranging, vigorous strain is usually a good choice for general and home use. These are often referred to as all-purpose strains. Your spawnmaker should tell you the optimum conditions for his or her spawn selections.

Most commercial operations select a sawdust form of spawn, but home gardeners may do better with the dowel or plug form. Dowels mature more slowly, but they are easier to inoculate. No special tool is needed with dowels.



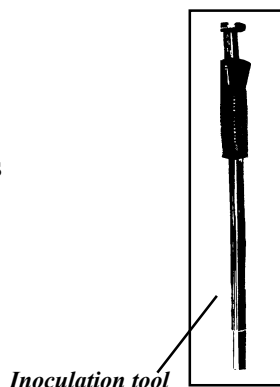
Starting a Log

Inoculation of the spawn into the substrate log should take place soon after cutting. If logs are left for several weeks, protect them from sun and drying. They may need to be rewet before inoculating. Drill holes about 1 inch deep into the logs. Hole size depends on inoculant form and tools.



Diamond pattern staggers hole placement

Spacing of holes is 7 to 9 inches in the row with rows 2 to 3 inches apart. High-speed drilling is helpful, as is a proper type of wood drill bit. A router works well. Stagger the holes and rows in a diamond pattern to allow for best spread of the fungus body called mycelium. You should have an inoculation of 10-12 holes per square feet of surface. Soon after holes are drilled, fill them with spawn. Avoid direct sun and drying conditions, which may kill the spawn. A special plunger tool injects the spawn, or a dowel is pushed into each hole. Each hole is capped with hot wax or a polyfoam plug to prevent drying.



Spawn Run

The inoculated logs are then stacked in a heavily shaded location where they will undergo their spawn run. This is when the log fills with mycelium and is a maturation before the first fruiting cycle. The spawn run lasts six to 10 months. During this time the logs must be protected from excessive moisture loss and have their moisture content adjusted through irrigation or soaking as needed. Do not let the logs dry down to firewood moisture levels or allow the bark to remain wet for long periods.

Spawn-run stacks are bulk stacked or generally stacked more tightly than fruiting stacks. Many stacking patterns are used to fruit shiitake. Stack patterns may be determined by choice of moisture adjustment technique. All this is done in heavy shade but exposed to natural rains.

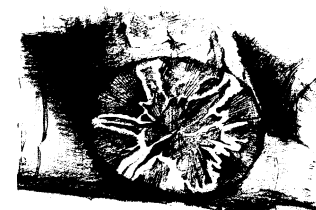
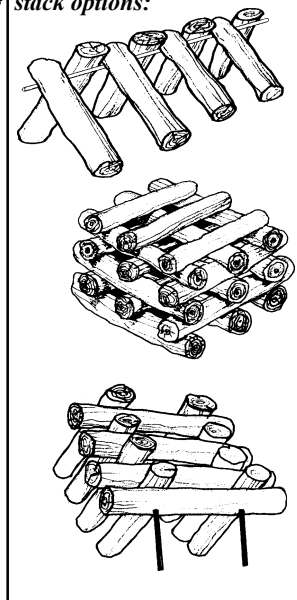
Maintenance and adjustment of log moisture content (LMC) between 30% and 70% are critical to the activity of the mycelium. LMC is the percentage of moisture of the total fresh weight. Do not depend on rainfall alone.

A convenient wetting technique is that of spraying the log stack. Logs may be sprayed for 6 or 24 hours, depending on log moisture requirement. Soaking logs for 12 to 20 hours is thought to be best for moisture regulation. It allows wetting of wood without extended wetting of the bark.

Special tanks may be made for soaking. A pond or stream may also work well. Water qualities have not been of significant concern, but avoid salty water and sources where *E. coli* might be present. Soaking water should be cooler than the log temperature. Humidity and airflow at the site can also help regulate LMC.

Logs are considered mature and ready to begin fruiting cycles when the mycelium has filled the log during the spawn run of six to 10 months. White mycelium appearing at the cut ends suggests maturity.

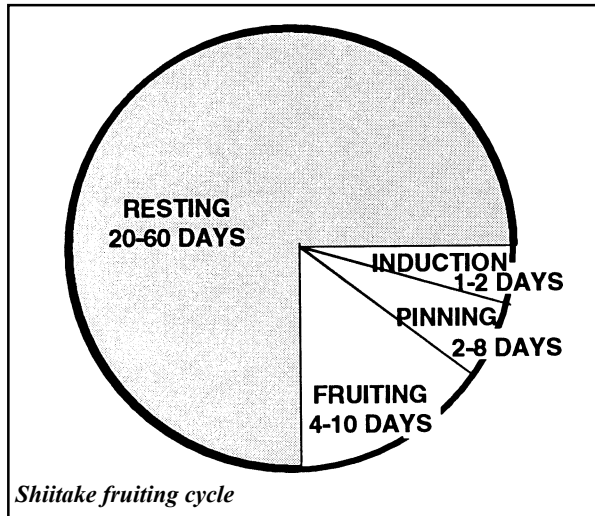
Three log stack options:



Mycelium pattern at log's end

Fruiting

The fruiting cycles, or periods between harvests, will go on for three or four years until the sapwood of the log is depleted or pest problems prevail. The length of the fruiting cycle depends on the spawn strain, temperatures and LMC. Good growing conditions mean minimal time between cycles. If logs are induced to fruit too soon, they may not fruit or may fruit very weakly.



To induce a mature mycelium to go into fruiting, bring the LMC to near saturation (80% to 90%) by soaking or spraying heavily. A 12- to 20-hour soaking works well. This alters nutrient availability and creates a stress, which causes the mycelium to go from vegetative to reproductive growth. A low temperature shock or even pounding the log can also help induce fruiting.

As the log dries down, the mycelium then starts to form reproductive nodules or buds under the bark. These nodules are called pins. The more pins that form, the more mushrooms. The pins then break through the bark and expand

into the spore-producing structures we call mushrooms.

The period from pinning to harvest may be done outdoors. Indoors, temperatures and humidity may be controlled at the optimum to hold the LMC at 55% to 60%. Some exposure to moderate or low light is necessary during fruiting for best

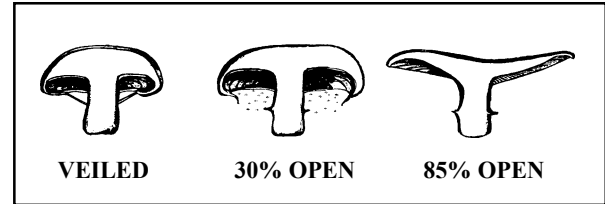
color development. Fruiting may take four days or 14 days, depending on temperatures.

Drying breezes can stop shiitake development. Mushrooms grow best at 60% to 85% humidity, but they should not receive moisture directly.

After harvest, indoor fruited logs are moved back out to the shaded laying yard. Here the mycelium will recover from fruiting and begin to restore foods for next fruiting. Don't disturb resting logs.

Harvesting and Processing

Mushrooms are harvested when the caps are 50% to 80% open. At this stage the gills are exposed, but the cap edges are still rolled under. The mushrooms are then cleaned, trimmed and made ready for market. Informal grading standards mirror USDA grades used for button mushrooms.



Drying can produce a quality product with a long shelf life. Most drying is done with heated air (100 degrees F to 120 degrees F) for about 12 hours. This produces a weight reduction of about 7 to 1. Sun drying is possible, but the quality is lower and there may be problems in humid climates.

Fresh market shiitake have a shelf life of about two weeks if handled properly. They are packed in 4-ounce containers or bulk packed in mushroom flats of up to 10 pounds. Package ventilation and refrigeration are important to maintain quality. Expect a moisture loss of 1% per day. Hold shiitake at 32 degrees F to 36 degrees F and high humidity (90%). The mushrooms freeze well with no special care.

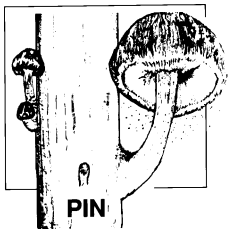
Pest Problems

Shiitake pests are mainly termites, flies and slugs, but squirrels, birds and deer can be a problem. Insect problems occur mainly when mushrooms are not harvested properly. Overmature mushrooms should be picked and removed. No chemicals are cleared for use on shiitake logs, so they are considered a natural or organically grown product. Weed fungi can invade the logs or bark and limit production. Other mushrooms should not be a problem for pickers since nothing else similar to shiitake will be growing on these logs.

Cost and Returns

Yields can vary. The best efficiency of log conversion reported is 33% of the log's dry weight into mushrooms over several years. Actual yields are more like 22% to 25%, assuming the log and bark are not damaged. Expect to average a little more than a pound of mushrooms per log per year.

Virginia's Extension Service estimates put start-up costs at about \$2,000 per 1,000 logs if you do the labor yourself. The fixed expenses needed for 1,000 logs over their four-year life are about \$6,000. This prorates start-up



costs over four years. Labor, at \$5.50 per hour, will cost at least \$3,740 over four years for the 1,000 logs.

Since shiitake logs are most productive in the second and third harvesting years, early cash flow may be a problem. In the third year, production should have leveled out if a portion of new logs is inoculated each year. To develop a 4,000-log operation, start about 1,300 logs each year.

A marginal wholesale price is \$4.50 per pound for fresh mushrooms. Production costs run about \$3 per pound for fresh mushrooms. Plan to phase in production at one-third of your unit annually to capitalize on the strong second-year production and improve your cash flow. A more desirable price of at least \$5.50 per pound wholesale improves net revenues significantly. Dried shiitake break even at about \$21 per pound.

Extension forester Mel Baughman of Minnesota has completed a shiitake production analysis. His major conclusions are that a moderate operation of 4,000 logs can give a good return to an investor after five years. If you claim labor and invest capital, you can expect a 6.5% return (after taxes) and an annual income around \$19,000, assuming no market problems exist. This return rate is most influenced by the amount of mushrooms sold and their farm price.

Reputable spawn makers want you to be successful with their spawn and can offer advice on production problems. Several companies offer a production book to be used with either log or sawdust production. Growers' organizations support producers in various ways. Your interaction with them is important to commercial success.

Income per 1,000 Shiitake Logs Year

	1	2	3	4
CWT Harvest	.075	22	15	6
CWT Sold	.065	17	13	4
gross (\$4.50)	\$293	\$7,650	\$5,850	\$1,800
gross (\$6.00)	\$390	\$10,200	\$7,800	\$2,400



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