

Cultivation of Shiitake Mushrooms on Logs

Introduction

This leaflet provides a potted version of how to grow Shiitake on logs. It cannot cover everything and in particular cannot cover the specific characteristics of your site. For example rainfall in Britain varies from below 24 to above 130 inches per year plus temperature and exposure to drying wind must also be considered. You therefore need to interpret these notes to best meet your requirements. If you have any questions please contact me.

The notes are arranged to give an introduction to the process starting by obtaining the correct logs and spawn, inoculation and the fruiting cycle.

Selecting the Best Timber

Type of Log

Hard wood logs are recommended. **Most growers use oak, beech or birch.** Pines or other soft woods are not recommended. Straight birch logs are fairly easy to obtain. They are less dense and can dry out more easily. The bark is tough and first mushrooms will appear only at the inoculation sites. Consequently they tend to be larger mushrooms. Beech has a soft bark which is easily damaged. It can fruit prolifically but is susceptible to colonisation by weed fungi. Direct sunlight can quickly lift the bark and ruin your log. Oak is a very dense wood with a resilient bark and large area of inner heartwood. The heartwood will take longer to colonise but will produce mushrooms over a longer period. Birch is colonised more rapidly than oak but does not fruit for as long.



Cutting and Buying Your Logs

The logs should be cut during the dormant season from healthy trees. The dormant period is the time from leaf fall in Autumn to just before the buds swell in Spring. Cut your logs just before you will inoculate them, try not to leave them lying more than 6 weeks and protect them from drying out. Keep the logs shaded from direct sunlight and strong winds. The longer they are left the greater the risk of contamination by other weed fungi. **We use straight logs 4 - 6 inches diameter, a metre (40 inches) long.** These are easily lifted and handled for fruiting etc. Smaller logs dry out too quickly. Larger diameter logs are harder to handle and take longer to colonise but ultimately produce more fruit.

The bark should be clean, free from earth and undamaged. Scars allow other fungi to invade plus the log to lose moisture. Ideally the log should have as few branches as possible. These should be cut off flush with the log surface and sealed with wax during the inoculation process.

Buying your logs can be difficult as **logs must not be split or the bark damaged.** Be clear with your woodman about your requirements and agree to pay only for those logs meeting your specifications. We estimate between 60 and 100 logs per ton depending on type and diameter. Expect to pay slightly over firewood prices due to the extra care required by the woodman.

Buying your Spawn

Order your spawn well in advance. It takes eight weeks to produce and we like to be able to produce spawn to meet your particular requirements and for it to be as fresh as possible.

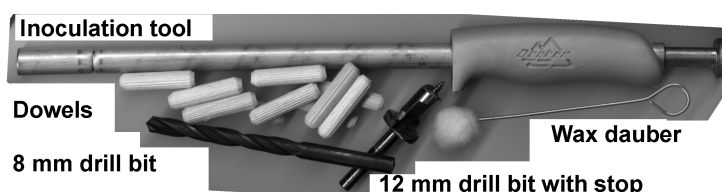
Care of Sawdust and Dowel Spawn

Spawn can be purchased on sawdust or dowel (grain spawn can be eaten by birds etc.). It should be white and fluffy when you receive it and matures to a chocolate brown. This is a normal process and will not affect the spawn. Proper handling of your spawn will maintain its quality. Check your spawn bags for any damage which may occur in shipping. Remove the spawn from the packing box. If bags are broken or damaged please contact us immediately. **Store spawn in a cool, dark, well ventilated environment until ready for use.** If you are not going to use the spawn within two weeks it should be refrigerated. If refrigerated remove the spawn 24 hours before use to allow it to warm. Do not freeze or expose spawn to strong sunlight.



Equipment

There are several tools necessary for inoculation and some tools which simply make the job easier.

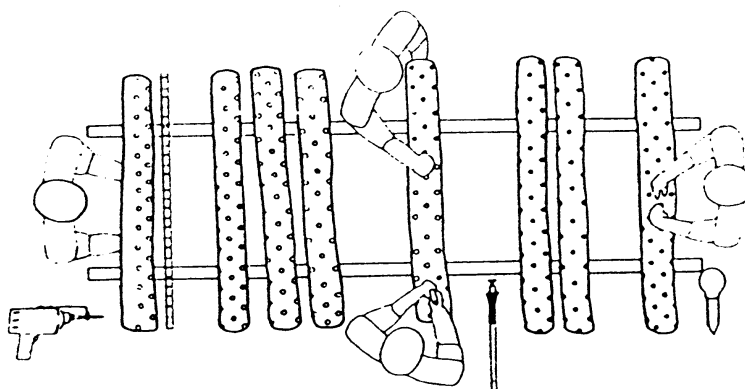


- * High speed drill (single speed, lightweight quite adequate)
- * Drill bit with depth stop (12 mm sawdust spawn, 8.5 mm dowel spawn)
- * Spawn inoculator (Sawdust spawn) or Hammer (dowel spawn)
- * Wax: cheese wax preferred as higher melting point.
- * Pan & stove or deep fat fryer for melting wax (an electric deep fat fryer works very well)
- * Wax applicator: fibre paint brush, turkey baster (metal or polypropylene) or wax dauber.
- * Accurate scales to weigh logs (only if you have them) .

Inoculation Process

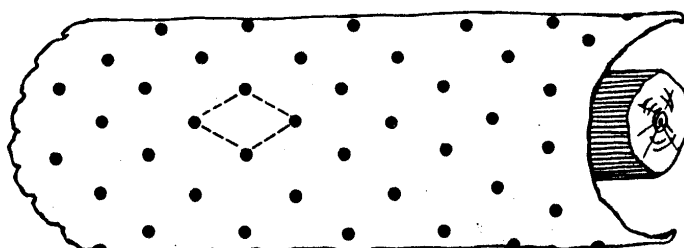
A log only needs to be inoculated once.

The mycelium grows through the log and decomposes the log over a period of four to six years. During this time it will produce mushrooms when temperature and moisture requirements are met. Holes are drilled into the log and the spawn is inserted into the holes. These inoculated points are then sealed with wax to stop the spawn drying out or being invaded by weed fungi. Logs need to be dry when they are inoculated. Handling of wet logs is hazardous and hot wax will not adhere.



Drilling

Drill 12 mm holes about 25 mm deep for **sawdust spawn**, 10 mm holes 1.5 times the length of the dowels for **dowel spawn**. Holes should be about 150 mm (6 inches) apart down the length of the log. The second row should be drilled 35-50 mm (1 1/2 to 2 inches) from the first with the holes staggered to form a diamond pattern. Drill extra holes near the ends of the log and around any branch or damage sites. Mushroom mycelium grows faster along the wood grain than across hence wider spacing along the grain. Repeat the process over the entire log and then immediately insert the spawn.





Spawn Inoculation

Sawdust spawn is best inoculated with an inoculation tool. The holes are filled so the spawn is almost level but slightly below the top surface of the bark. Sawdust spawn can be placed into the holes by hand if you do not have an inoculation tool. However this method is time consuming and exposes the spawn to more contamination. **Dowel spawn** pegs can be tapped flush with a hammer.

Immediately all the holes in the log are filled they are sealed with hot wax to stop the spawn drying out or becoming contaminated.

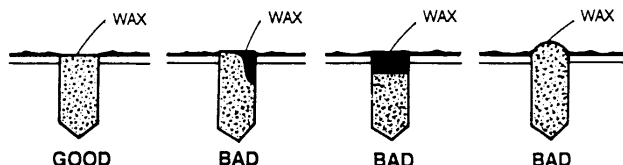


Waxing

We use cheese wax as it is food safe, adheres to the log and does not easily chip or melt in strong sunlight. You can use bees wax or paraffin wax but we have found them less satisfactory. All inoculation holes, damaged bark and cut branch ends should be sealed with liquid wax. **Wax should be really hot and sizzle on top of the spawn.** This will only kill the a thin layer on top of the spawn plus any contamination around the inoculation sight, don't worry the spawn will soon recover. : **Wax can be melted in a pot over a stove and applied with a brush or dauber. We use an old deep**

fat fryer and a turkey baster modified with a nail to limit flow. CARE MUST BE TAKEN. HOT WAX IS HIGHLY INFLAMMABLE AND CAN CAUSE SERIOUS BURNS.

DIRECTIONS FOR WAX SEALING



Stacking and Positioning of Logs

Spawn run, the waiting period.

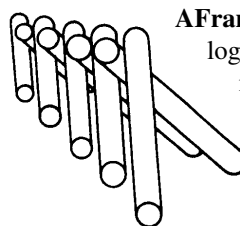
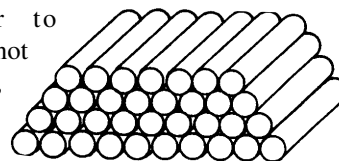
In order to produce mushrooms the wood must degrade. This requires environmental conditions which will encourage mycelial growth. A warm, moist (but not wet) area with good shade (70% shade) and sheltered from strong wind is ideal. It is important that logs do not dry out, become saturated with water or the surface of the log get too hot.

You can periodically weigh some of your logs and calculate moisture loss, which should not be more than 10%. This requires a fairly accurate balance. **Look for any significant cracking of the log ends, this also indicates drying out.** This can be remedied by spraying, soaking with water or by laying the logs directly on the moist ground. Re-stack once the log regains moisture.

Stack your logs facing south if possible to maximise solar gain. Try to maintain summer temperatures of 15-27°C (60-80°F) and a relative humidity of 80-85%.

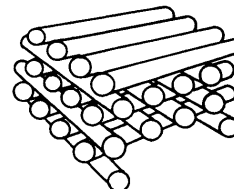
If the logs get too wet stack them upright to increase air flow around the logs surface. You will have to keep an eye on your logs and make adjustments as environmental conditions change. The length of time required for mycelium to grow through the log will vary from 6 - 24 months depending upon spawn type, environmental conditions, the size of the log and the timber species used. The mycelium grows through the logs and can first be seen as 'V' shaped white markings at the ends of the log. At first the growth will correspond with inoculation sites. The mycelium is whitish in colour, becoming brown as it matures to fruiting.

Log Store: This is good for storing logs prior to inoculation. It does not provide air circulation, restricts water penetration, allows water to stand on the logs so it is not good for the spawn run.

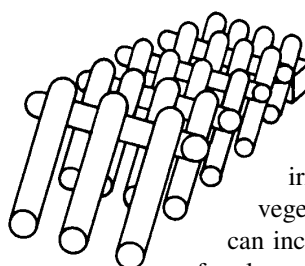


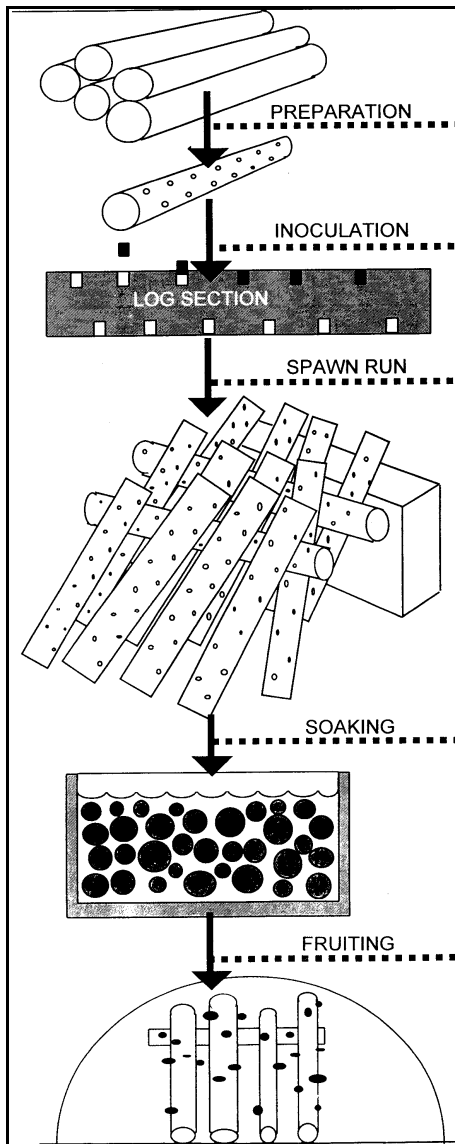
AFrame: Can be good for a few logs and for fruiting. Take care not to increase the stacking angle. Can allow too much air circulation and drying of logs. Good for humid high rainfall areas.

Cross stack: In the right conditions can be a good stacking method. However logs on top tend to dry out, lower logs get saturated.



Lean-to: This is the stack we recommend. It is easy to manage to meet particular site conditions. In moist areas a steeper angle allows rain to drain, in very dry sites the logs are barely off the ground. Stagger logs to achieve maximum benefit from rain and irrigation. Allowing vegetation to grow through can increase humidity but watch for slugs.





Fruiting & Soaking

The time to the first flush of mushrooms varies greatly depending on the spawn run. Most mushrooms respond to environmental stress which signals that it is time to seek new places to grow. **Rainfall, movement and or temperature changes can induce fruiting.** This is best illustrated with wild mushrooms produced in abundance in the spring and autumn.

Soaking

A good indication that your log is ready to fruit is the butt ends changing from being covered in white mycelium to areas of chocolate brown. You may also notice one or two mushrooms developing after heavy rain **Three factors stimulate fruiting 1. drop in temperature. 2. increase in moisture levels. 3. Movement.** These conditions can be reproduced by completely immersing logs in cold water for 24-48 hours. The log should not be left in the tank to long as the mushroom mycelium needs to breath. Suitable containers range from dustbins, old baths to purpose built soak tanks. Water should be fresh, clean and as cold as possible and should remain cold during the soaking e.g. avoid any solar gain etc. It should be changed for each load of logs. Logs should be as warm as possible, I put logs to soak mid afternoon. Logs must be held down to prevent them floating to the surface. Care must be taken not to damage the bark. **A more effective shock is achieved if there is the greatest difference between log temperature and water temperature.** It is important not to move your logs for 4 weeks before soaking. **Only move them on the day you put them in the soak tank.**

Pinning and Fruiting

After soaking stack vertically in a shaded, **moist (85% humidity)** shed or shaded polytunnel (beware of slugs). **Temperature 12 to 24°C (55 to 75°F).** **Shiitake mushrooms need some light to develop.** Mushrooms should begin to appear one to three weeks after soaking (depending on strain and temperature). The first thing you see are small white nods emerging from the inoculation sites (pinning). The mushrooms will be ready to pick in less than a week. The ideal time to harvest is when the cap edges are starting to unrolled shortly after the veil breaks, (about 25%

of the gills showing). Pick by grasping firmly at the base of the stem and twisting the mushroom from the log (we then trim the stems). Fruiting may last for up to four weeks with new mushrooms developing throughout this time. **Humidity and log moisture levels must be maintained through out.** In cooler temperatures the fruit develops more slowly. After fruiting return the logs to the shady site for resting. The **shock / fruit / rest cycle** can continue two to four times per year (every 10 to 12 weeks) for up to five years depending on the size and type of log. Fruiting should peak in the second or third year. With proper husbandry the average total crop can be up to a third of the dry weight of the log. When they have ceased fruiting logs are unlikely to burn well. They can be 'retired' from shocking and placed to one side to fruit naturally for a few extra mushrooms then left to decompose on the forest floor or on your compost heap.

Successful cultivation of exotic mushrooms, as with any crop, is dependent on a wide range of factors.