

Spawning in Shiitake Log Cultivation with a Spawning Gun

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Log cultivation vs sawdust bag cultivation

Shiitake, which is a wood-decaying fungus, has long been cultivated on logs. Since it was found that Shiitake could be cultivated on synthetic media made of sawdust or wood chips and that the use of them shortens the production cycle, Shiitake sawdust bag cultivation has been developed continuously. Now, it is one of the main cultivation methods along with log cultivation.

Log cultivation, known to have been first established in the Northeast Asia, has been mainly used by Shiitake growers in Korea and Japan. However, in Japan, many growers have converted to sawdust bag cultivation, so only half of total growers are using log cultivation now.



Shiitake logs cultivation outdoors (Korea)



Logs during spawn run (Korea)

Sawdust cultivation has a relatively short history, compared to log cultivation. But most of shiitake production in the world comes from sawdust bags. It is because almost 100% of Shiitake production in China, which occupies about 90% in world shiitake market, is from sawdust bag. Besides, most shiitake growers in the world also employ bag cultivation methods.

They commonly use sawdust and wood chips, but the shapes of bags are different in different countries: rectangular block, columnnar, and broad or slender cylindrical.

[Various shapes of sawdust bag]



Rectangular block-shaped substrate bags (Japan)



Columns of substrate bags (China)



Slender cylindrical (China)



Broad cylindrical (China)

Sawdust cultivation has many advantages, but this article is going to deal with only about log cultivation. If you are interested in sawdust cultivation, the following articles about sawdust cultivation provided by MushWorld are recommended for you.

[Shiitake cultivation on sawdust](#) by Daejin Lee
[Substrate Preparation for Shiitake Cultivation](#) by Hyunjong Kwon
[Facilities and Equipment for Substrate Preparation](#) by Hyunjong Kwon (Miji)
[Cultivation of *Lentinula edodes* on Synthetic logs \(1\)](#) by Alice W. Chen
[Cultivation of *Lentinula edodes* on Synthetic logs \(2\)](#) by Alice W. Chen
[Shiitake Bag Cultivation in Korea](#) by Richard Kang
[\[Moving picture\]Sawdust Plug Spawn Making & Inoculation](#) by Richard Kang

Going back to log cultivation, the subject of this article, why do shiitake growers using logs insist on log cultivation, even though they know many advantages of sawdust cultivation? Their answer is 'Quality.' It is certain that they can produce high quality shiitake, and quality is directly related to the price.

Production cycle is long in shiitake log cultivation. For example, if we inoculate logs this spring (usually in March), we can have the first harvest in the following late spring or early summer (about 15months later), and after the first harvest, we can continue to harvest usually every 2-4 years.

The first thing to do to grow shiitake on logs is preparing logs. As a good medium is an important factor for successful mushroom production, the quality of the logs, that is a medium in log cultivation, is very important. Some growers who can afford to purchase forest lands do so in order to secure quality logs. However, it is more common to buy logs cut in proper length and width.

Requirements of logs for shiitake production

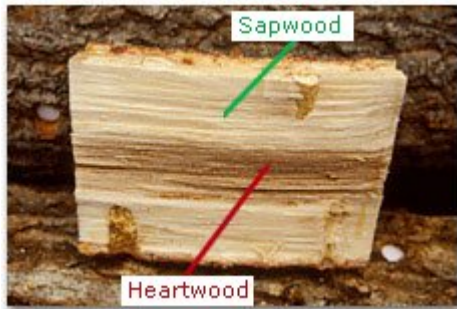


Proper logs: well-dried with a few cracks



Wide sapwood, thin heartwood is preferred.

First, logs should contain adequate moisture content. A rule of thumb is that if the logs have thin cracks enough for a coin to be put in, they have an appropriate log moisture content .



Vertical section of the log inoculated a year ago.

Second, sapwood section of logs should be wide and heartwood section should be thin. The picture in right side explains the reason. In the picture, lighter section is the sapwood colonized by mycelia for a year after inoculation. However, although a year has passed since inoculation, mycelia couldn ' t grow into heartwood (relatively darker section in the picture). The wider sapwood logs have the more nutrition to provide for shiitake mycelia.

'Log preparation ' is so important that an extensive study has been done only on this theme. If you want to learn more about log preparation, please refer to the links below.

[Inoculation of Logs for Shiitake Cultivation](#) by Taesoo Lee
[Log preparation and Incubation of Shiitake](#) by Kun-ho You
[Selection of Trees and Log Preparation](#) by Kun-ho You

Sawdust spawn inoculation

There are two types shiitake spawn according to its shape: sawdust spawn and plug spawn. Plug spawn has two types: sawdust plug spawn and wooden plug spawn. We will see inoculation practices using sawdust spawn and plug spawn.

Spawn preparation

Depending on the ways of cultivation, proper strains should be selected. Most spawn providers have different strains with specialized characteristics for the use in either log or sawdust cultivation. In addition, the adaptability for temperature, humidity and moisture content should be considered.



Bottle cutter



Spawn shredder

Spawn is shredded after cut in half. The size of spawn particles can be controlled by adjusting the spinning speed and arrangement of shredder's blade. The workplace should be clean and

disinfected to minimize possible contamination risk.

Log Preparation

The proper inoculation hole size is 10mm in diameter and 20-25mm in depth. The diameter of hole is determined by the diameter of a drill bit.

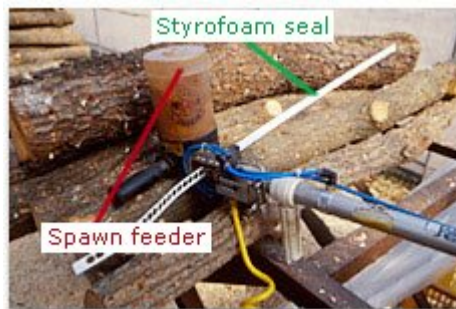
To minimize possible contamination, it is recommended that the logs are inoculated right after the holes are drilled in logs. Generally, drilling and spawning are done at the same time.



Drilling patterns affect mycelial growth rate. In many cases, inoculation holes are spaced at 5cm intervals along the longitudinal direction, with about 10-15cm apart. More details will be discussed below.

Spawning

Spawning gun inserts sawdust spawn using compressed air and covers the spawned hole with Styrofoam seal at the same time. Inoculation hole is completely filled even without any tiny space. However, excessive compression could be harmful to mycelial growth. These two properties make inoculation with spawning gun different from that with plug spawn.



Spawning gun



Spawning gun loading

First, spawning gun is filled with well-shredded spawn. In this procedure, growers should be careful not to contaminate the spawn. Spawn should not be exposed to sunlight and air for a long time. The work surface should be disinfected with lime powder.

Inoculation

The spawning gun inserts spawn and covers the spawned hole with a Styrofoam seal at the same time. Growers should take a careful sight of inoculation hole, and then shot spawn into the hole. During inoculation, spawn and Styrofoam should be provided continuously.



Inoculation



Inoculated logs

Inoculated logs are stacked in the way of bulk stack for 1-2 months to keep temperature and humidity consistent, and promote mycelial growth. It takes more than a year for spawn run, and restacking in different ways according to the growth stage is required. There are various ways of stacking during spawn run, such as crib stack, lean-to stack, and A-frame stack.

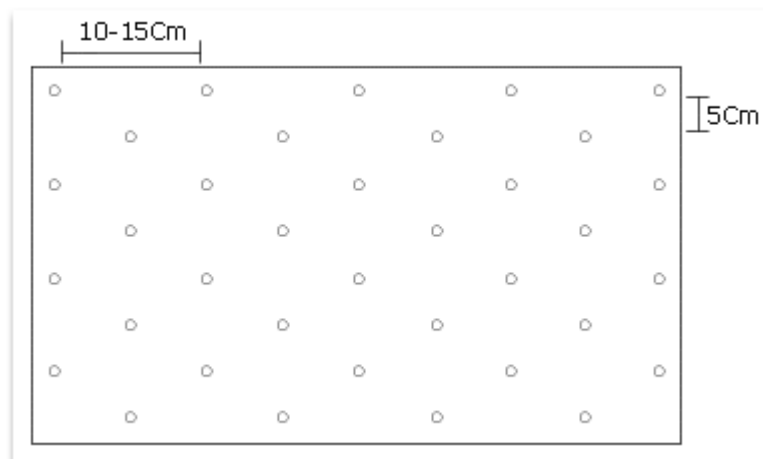
Shiitake mycelia (shredded, i.e. damaged) start regrowth after recovery, when proper log moisture content should be maintained. If the inoculated area turns into white, it implies mycelia start to regrow after recovery.



Inoculation hole right after inoculation and one month later

White mycelial growth means that mycelia recovered and resumed its growth.

Patterns for Inoculation



Diamond pattern for inoculation

Here 's an important tip regarding inoculation pattern. The figure below shows an arrangement of inoculation holes on a log. Rows are spaced at 5cm intervals around the circumference and 10-15cm apart within each row. However, experienced growers advise that the interval in horizontal direction is not that important, but the interval in longitudinal direction is better to shorten to 3cm.

This is because mycelia grow along the grain.

Paul Przybylowicz and John Donoghue explain it in thier 'Shiitake Growers Handbook.'

"Shiitake grows much faster along the grain than across it due to the orientation of cells in the

wood. In fact, after nine months incubation, growth with the grain is six to ten times greater. The grower should select an inoculation pattern that uses the differential growth to achieve rapid, even colonization."



Colonization along the grain



Infection with disease fungus

Because of this, if the interval between rows is too wide, shiitake mycelia cannot colonize the log evenly. That means a greater contamination risk for other competing or disease fungi can intrude deep into the log without any obstruction. They could compete with shiitake mycelia for space or nutrients in the log, or inhibit the growth of shiitake mycelia. This figure shows the penetration path of disease fungus. It entered the log in the less colonized area, with a wide interval between rows, where the vigor of shiitake mycelia was relatively weak. Growers can prevent the access by harmful fungi by reducing the interval between rows of inoculation holes.