



GUIDE TO MUSHROOM CULTIVATION ON LOGS OBTAINED FROM PRUNING IN MEDITERRANEAN SILVOPASTURE SYSTEMS



November 2021

Guide to mushroom cultivation on logs obtained from pruning in Mediterranean silvopasture systems

What is the purpose of this guide?

The main objective of this manual is to explain the mushroom production technique that is best adapted to the conditions imposed by the silvopasture system of dehesa. Based on the experiences carried out by the IDForest-Biotecnología Forestal Aplicada, S.L. within the LIFE Regenerate project, conclusions about mushroom production in dehesas are:

- The use of pruning chips as a substrate for mushroom production turns out to be a system that involves making a large investment and unjustified energy expenditure.
- The use of logs obtained from pruning or thinning as a substrate is the most efficient system in terms of technical, economic and energy terms. For this reason, this handbook will focus on the explanation of this technique for the conditions imposed by dehesa characteristics.

What are the benefits of mushroom production in pruning logs?

The benefits of using logs for growing mushrooms are:

1. Obtaining a new edible and marketable product that constitutes a new source of economic benefit to the owner of the land.
2. Use of a by-product (logs derived from pruning and thinning) whose current economic value is very low.

What do we need to grow mushrooms on logs?

As for any production process, a series of inputs will be required. In the particular case of mushroom production, two key elements will always be needed:

- A **substrate** necessary for growing and fruiting of saprotrophic fungi. In this case, the substrate will be the woody logs. Woody species that allow the fungus to develop properly in the case of the Mediterranean silvopasture systems, include: holm oak (*Quercus ilex*), cork oak (*Quercus suber*), Pyrenean oak (*Quercus pyrenaica*), Portuguese oak (*Quercus faginea*), Andalusian oak (*Quercus canariensis*), black poplar (*Populus nigra*), white poplar (*Populus alba*). In order to obtain the logs, following recommendations should be followed:

- Logs must be obtained from **healthy, living trees**. Dead, dry or sick parts cannot be used. If during the cutting process any rot or mycelium of a fungus is observed inside the trunk, it should be discarded and the cutting tools (chainsaw, ax, saw, etc.) should be disinfected.
- Logs must be obtained during the **vegetative stop** of the trees.
- Logs must have a dimension of **10-20 cm in diameter and 100-120 cm long**. If possible, logs should be selected so that they have as little curvature as possible.-

- A pure **inoculum** of the fungus, which will be introduced into that substrate to start its colonization. They must be saprophytic species (capable of growing on plant remains). Some of the most commonly used edible and medicinal fungal species are: shiitake (*Lentinula edodes*), oyster mushroom (*Pleurotus ostreatus*), hedgehog mushroom (*Hericium erinaceum*), reishi (*Ganoderma lucidum*) or turkey tail. (*Trametes versicolor*). This inoculum can be presented in different ways:

- Inoculated beech wood dowels. This material can be found in different diameters (8-12 mm usually)
- - Sawdust or hardwood chips (for example poplar, beech, oak, chestnut, etc)
- - Cereal grain such as millet, rye, wheat, etc.



Figure 1: Different forms of presentation of fungal inoculum. From left to right: dowels of wood, sawdust or chips and cereal grain (in this case millet). Own source.

How are mushrooms grown?

The steps to follow for growing mushrooms on logs are as follows:

1. Inoculation:

- ✓ **Drill about 30-50 holes per log**, with a wood bit of a diameter equal to or 1-2 mm greater than that of the dowels (if this type of inoculum is going to be used). They will be arranged in staggered rows, following the longitudinal axis of the trunk. The depth of the holes will be enough to fit the full dowel, or in case of inserting wood chips or grain, it will be 30-40 mm approximately.
- ✓ **Introduce the mycelium:** Either with the help of a hammer (dowels) or with a hand-held inoculator. It is necessary to be compacted so that the mycelium is in contact with the wood.
- ✓ **Cover each inoculation point** to prevent the fungus from drying out. Hot wax is usually used, applied with a brush or sponge.



Figure 2: Inoculation process. From left to right: opening of the holes and introduction of the mycelium (dowels in the first photograph, inoculator in the second). Right: cover with hot wax to avoid drying out. Own source.

2. **Incubation:** process by which the mycelium colonizes the trunk. This phase is slow and its duration will depend on the characteristics of the wood used and the asepis, humidity, insolation and ventilation conditions. This process usually takes up to a year. That is why, if it is inoculated during the spring, we will not have the trunks fully colonized until the spring of the following year to put them to fruit. When carrying out the incubation, it is advisable to take into account the following considerations:

- ✓ The trunk must not dry out at any time
- ✓ They must be in a permanently shaded and cool area.
- ✓ Avoid places with a lot of ventilation
- ✓ Logs can be stacked and covered to slow moisture loss. They can be covered with a waterproof canvas or plastic. In very dry places they can be placed in a hole in the ground to avoid drying out, always previously wrapped in plastic to avoid contamination. In case of moisture loss it is necessary to water the trunks.

3. **Mushroom production:** Once the trunks have been completely colonized by the mycelium of the fungus, they can start to produce mushrooms. To know that they have been colonized, it is necessary to check that at the ends of the trunk we can see that they are covered by the mycelium of the fungus (whitish appearance).



Figure 3: Inoculation and production start. Left: Covering the pile of logs with plastic to prevent them from drying out. Right: Holm oak trunk inoculated with shiitake in which the whitish-looking mycelium is beginning to be seen on the upper part. Own source.

At that time, production can be stimulated as follows:

- ✓ Completely immerse the log in dechlorinated water for 24 hours at room temperature. To remove chlorine from mains water (if it is from a well or spring it would not be necessary) it is enough to keep the water in an open container for 24 hours.
- ✓ After that time, arrange the logs as follows:

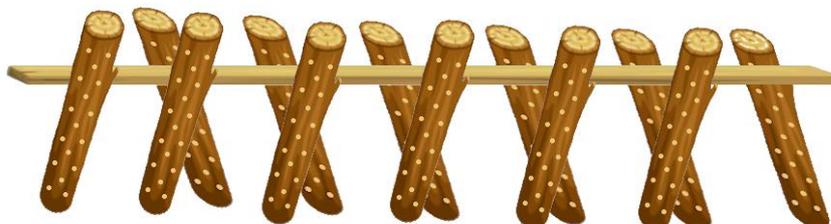


Figure 4: Placement of the trunks for fruiting. Own source.

- ✓ Do not let the logs lose moisture by watering periodically.

4. Harvesting: When the mushrooms of the first bloom (production) are already appearing, the following must be taken into consideration:

- ✓ They must be cut when they have the appropriate commercial sizes, avoiding that they are very young or excessively ripe.
- ✓ The extraction of the mushrooms from the trunk must be done through clean cuts flush with the bark, with a previously disinfected tool.
- ✓ After each production, the trunk will need about 3 months of rest until the next production. To do this, proceed in the same way as during the initial incubation. The trunk has to recover in terms of nutrients until it can be submerged again for about 24 hours and to cause a new production.
- ✓ The trunks of the densest woods (holm oak, Portuguese oak, and Pyrenean oak) can produce for 4 years with about 2 or 3 blooms per year.

References

- Bruhn, J. N., Mihail, J. D., & Pickens, J. B. (2009). Forest farming of shiitake mushrooms: An integrated evaluation of management practices. *Bioresource technology*, 100(24), 6472-6480.
- Chakravarty, B. (2011). Trends in mushroom cultivation and breeding. *Australian Journal of Agricultural Engineering*, 2(4), 102-109.
- Leatham, G. F. (1981). Cultivation of shiitake, the Japanese forest mushroom, on logs: a potential industry for the United States. Forest Products Laboratory.
- Mudge, K. (2013). Best management practices for log-based shiitake cultivation in the northeastern United States. University of Vermont, Extension.
- Stamets, P., & Chilton, J. S. (1983). *The mushroom cultivator*. First Washington.
- Stamets, P. (1993). *Growing gourmet and medicinal mushroom*. Ten Speed Press. ISBN:0-89815-608-4.

Disclaimer

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of the European Commission or the LIFE programme.

***To quote the guide please use the following reference:
Biotecnología Forestal Aplicada, Guide to mushroom cultivation on logs obtained from pruning in Mediterranean silvopasture systems (2022).***

*Reproduction of any text, images, or graphs in this guide is restricted by Biotecnología Forestal Aplicada S.L. For inquires/requests please contact **info@idforest.es***

This publication is co-funded by the European Commission through the LIFE Regenerate project (LIFE16 ENV/ES/000276).