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COMPARATIVE STUDY ON YIELD OF EDIBLE LOCAL MUSHROOM USING DIFFERENT CARRIERS OF SPAWN

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ABSTRACT

The source and quality of the seeds influence the final result of mushroom production. Most mushroom seeds are cereals, wheat seeds, sorghum, and corn used as carrier materials for mushroom mycelium. An important process to note is when inoculating the seeds into the media bag. This inoculation process requires good skills and focus to avoid contamination, time, and material efficiency. Mycelium seeds can be made using sawdust, rice straw, or wood as carrier materials. This media makes it easier to hold and inoculate the seeds into the media because of its sturdy shape compared to using seed seeds. The edible mushroom strains, namely Pleurotus pulmonarius, Pleurotus florida, and Schizophyllum commune, are propagated through wood pellets for mycelium colonization. Mycelium colonization on pellets is used for inoculation into substrate bags. The production cost of pellet seeds is 30% cheaper in mass production than seed seeds. Inoculation of pellet seeds into mushroom bag substrates is also easier and faster compared to seed seeds. Another advantage is that the inoculation time is faster compared to conventional methods. The use of pellet seeds for mushroom production is generally still little developed by farmers. Pellet seeds are an easy, cheap, and practical inoculation alternative for mushroom farmers.

*Keywords**:** seeds; inoculation; production; mycelium; pellets;*

INTRODUCTION

Mushroom cultivation involves specific technical know-how, however, the existing local mushroom growers are still practicing obsolete technology and using mushroom cultures that were developed back in the 1970s. The public has a misconception that the mushroom industry is well-established. Mushroom growers are facing many problems, foremost, in spawn production and cultivation technology.

Most of the spawns use grains as a substrate to become fully colonized by the mushroom mycelium (Ganisan, 2011; Khulidin *et al*., 2012). Sorghum, corn, and wheat are mostly used for spawn production. The inoculation of spawn into mushroom bag substrate requires a skill to avoid contamination and wastage of the spawn (Khairul Asfamawi, Ahmad Fuad, Mohd Irwani Hafiz, Hafiz. Aizat, *et al*., 2017). Furthermore, the inoculation processes take a certain period and it's labor intensive. No tools are required in the inoculation process, whether grain or pellet spawns. However, the inoculation process using wood pellet spawn is shown to be easy and fast, relatively compared with the use of grain spawn. Neither standard of procedure (SOP) for wood pellet spawns nor wood pellet spawns' production was practiced among local mushroom growers. Therefore, pellet spawn seems to be an alternative spawn for further improvement of the inoculation process. Fungi are heterotrophic microscopic organisms that obtain nutrients through absorption. In the classification of living things, fungi are placed in the kingdom of fungi which are different from plants and animals. Food mushrooms, which we can eat, have a distinctive taste and are loved by many people. We can get this mushroom from cultivation or nature. Due to their high nutritional content, mushrooms are often referred to as functional foodstuffs. Both in fresh and processed form, mushrooms are very good for health, especially for growing babies (Inayah & Prima, 2022).

Given the great potential of mushrooms for health, efforts need to be made to accelerate the growth of white oyster mushrooms. To maximize the health potential of the fungus, the growth time of the mycelium needs to be accelerated to less than 45 days, and the time for sprouts to appear to be less than a week. Research shows that the administration of growth hormone in the planting medium has the potential to reduce the growth time of mycelium and accelerate the emergence of shoots (Alqamari, 2022). This mushroom can be an alternative source of protein because it contains quite high protein. In addition to being high in protein, oyster mushrooms also contain quite high carbohydrates, fat, and fiber. Its protein content, especially essential amino acids, makes it a nutritious source of protein (Anggraeni *et al*., 2023). In addition, oyster mushroom cultivation also contributes to environmental conservation by utilizing waste such as sawdust or straw as a planting medium. The oyster mushroom cultivation approach has proven to be effective in improving people's living standards by increasing income, food availability, and quality of life in general (Machfudi *et al*., 2021). This natural waste has great potential because of its large nature, contains polymer substances that accelerate the processing process and is environmentally friendly. In addition, its abundant availability and low price make it very profitable (Nurzanah & Dewi, 2024). Oyster mushroom cultivation is very profitable because of its convenience. This fungus has a high tolerance to various environmental conditions, such as temperature and pH. In addition, oyster mushrooms are also productive in producing large quantities of fruit, do not require a complicated composting process, and are relatively resistant to disease and pest attacks (Ejigu *et al*., 2022). The mushroom cultivation process involves identifying and selecting mushroom varieties, isolating pure cultures, making seed growth media, preparing planting media, and ending with the fruit production stage (Shanthipriya Ajmera *et al.*, 2022). The process of making mushroom seeds goes through several stages or generations. Early seedlings (F0) are cultivated on potato dextrose Agar (PDA) media. The next generation of seedlings (F1, F2, and F3) are produced in succession, with F3 being ready-to-plant seedlings on the growing medium (Kadir *et al*., 2024).

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dextrose Agar (PDA) media. The next generation of seedlings (F1, F2, and F3) are produced in succession, with F3 being ready-to-plant seedlings on the growing medium (Suparti & Zubaidah, 2018). The carbohydrates in PDA serve as the main source of energy for mushrooms, so this medium is very suitable for the growth and development of mushrooms (Nurdin & Nurdin, 2020). Thus, this study aims to determine the potential of pellet spawn instead of grains on the yield performance of selected local mushrooms and its practical inoculation process based on time.

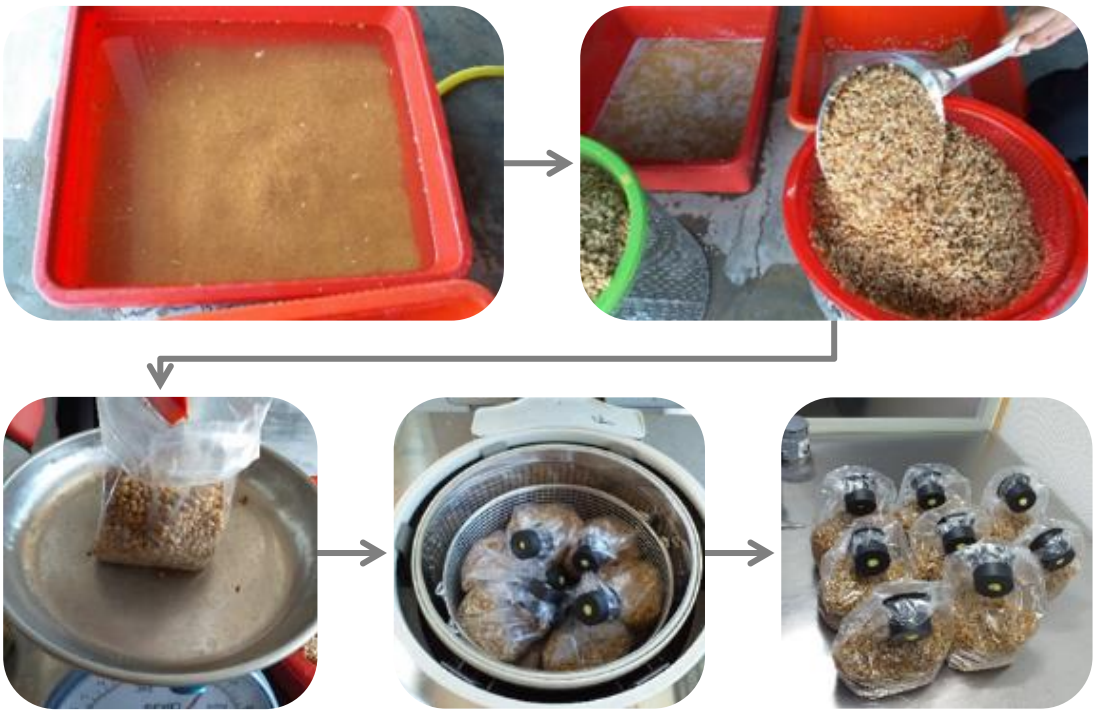
MATERIALS AND METHODS

Strain

Three types of strain used were *Pleurotus pulmonarius* (Grey oyster mushroom), *Pleurotus florida* (White oyster mushroom), *Auricularia sp.* (Black fungus mushroom), and *Schizophyllum commune* (Split gill mushroom) were obtained from Spawn Production Laboratory, Soil Science, Water and Fertilizer Research Centre, MARDI Headquarters, Serdang, Selangor. All the strain was preserved in slant agar at 4°C and subcultured every three months.

Grains and wood pellet preparation

The wheat grain spawns were prepared using a method of spawn preparation outlined by Ganisan (2011) (Picture 1). Meanwhile, the wood pellets in a size of 6mm x 30mm (Wolfcract, Germany), were prepared by thoroughly washed with distilled water and then autoclaved for 21 mins at 121ºC (Hirayama, Japan). Media sterilization is a crucial process in oyster mushroom cultivation because the prepared media often still contains a large number of microbes, especially wild mushrooms. Many crop failures are caused by imperfections in the process of sterilizing the media. Wild mushrooms that are still in the growing medium will grow very quickly and hinder the growth of white oyster mushrooms if the sterilization process is not carried out properly (Alridiwirsah *et al.*, 2022).



Picture 1. The Process of Preparation of Wheat Grains Outlined by Ganisan (2011)

Grains and wood pellets spawning

One cm2 culture of *P. pulmonarius*, *P. florida*, *Auricularia sp.*, and *S. commune* was inoculated into sterilized wheat grains and wood pellets, aseptically. Thereafter, all mushroom cultures were incubated (Memmert, Germany). The process can be seen in Picture 2 and 3.

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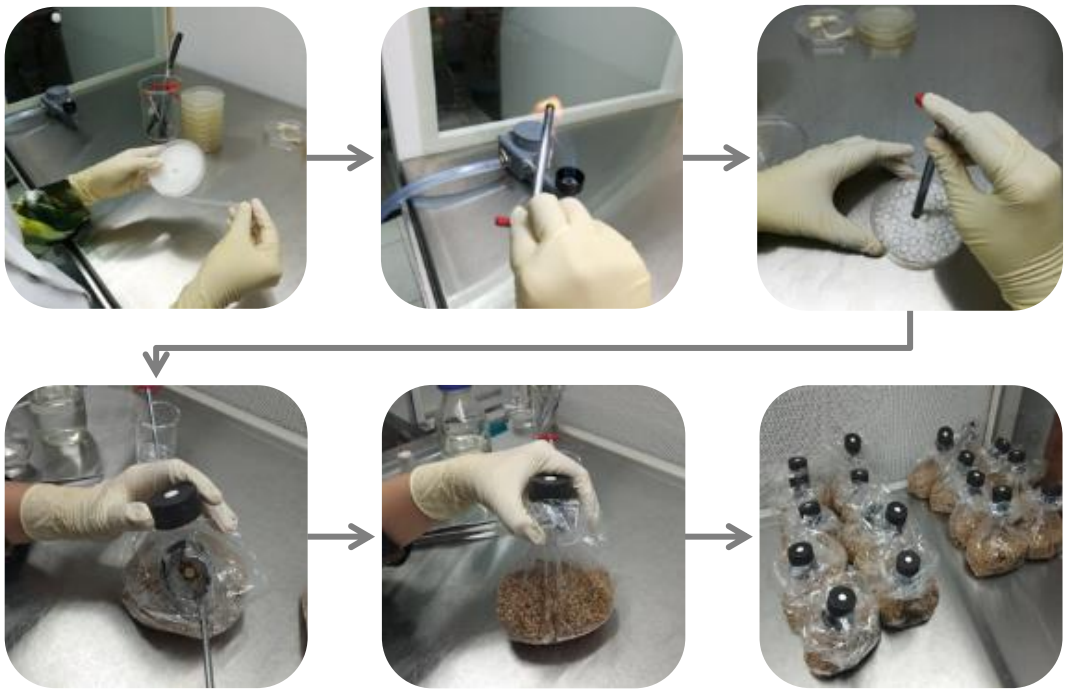
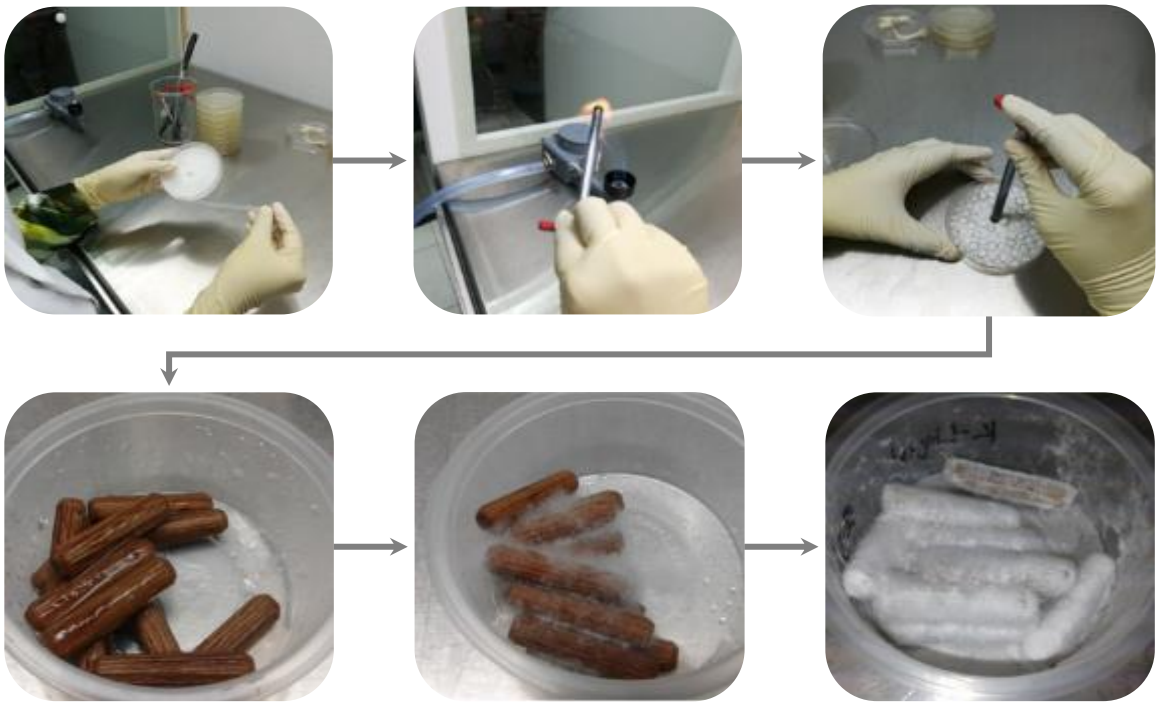


Picture 2. The Process of Inoculation of Selected Edible Local Mushrooms into Wheat Grains



Picture 3. The Process of Inoculation of Selected Edible Local Mushrooms into Wood Pellets.

The incubation process of oyster mushrooms is carried out in a special room with optimal temperature and humidity settings. The room temperature is maintained between 27-30 ºC and the relative humidity is 60-70%. The mushroom baglog is placed horizontally on a wooden rack and the incubation process is terminated after 5-6 weeks, characterized by the growth of a perfect mycelium covering the entire surface of the growing medium (Sugianto, 2023).

Mushroom growth

Mushroom substrate bags were prepared and pasteurized. The growth of *P. pulmonarius*, *P. florida*, and *Auricularia sp.* was done at Control Environmental Mushroom House (CEMH), Engineering Research Center, MARDI Headquarters, Serdang, Selangor. The time (number of days) required from inoculation to completion of mycelium running, the time elapsed between opening the plastic bags to pinhead formation, and the time required from opening the plastic bags to first-round harvesting were recorded as described by Khulidin *et al*. (2012). Meanwhile, the *S. commune* was growing at the Spawn Production Laboratory, Soil Science, Water and Fertilizer Research Centre, MARDI Headquarters, Serdang, Selangor as described by Khairul Asfamawi *et al*. (2017). The composition of PDA combines natural ingredients such as potatoes with synthetic materials such as dextrose and agar. Therefore, PDA is categorized as a semi-synthetic planting medium. In PDA media, potatoes function as a source of carbon, vitamins, and energy for microorganisms. Dextrose acts as an easy-to-use source of sugar, while agar functions as a thickening agent (Arifah, 2019). The carbohydrates in PDA serve as the main source of energy for mushrooms, so this medium is very suitable for the growth and development of mushrooms (Nurdin & Nurdin, 2020).

Inoculation process based on time (mins)

Both grains and wood pellets spawn were inoculated into pasteurized mushroom substrate bags. The process of inoculation was measured based on the quantity of mushroom substrate bags per minute per person. Data has been analyzed by Microsoft Excel software using comparison data as a simple analysis based on time, quantity, and cost. Each treatment is done in triplicate. Furthermore, the lack of application of aseptic techniques in the inoculation process and the poor quality of mushroom broodstock are the main factors causing contamination in the mushroom planting medium. Contaminants can compete with the fungal mycelium for nutrients, so the growth of the fungus is inhibited (Suparti & Karimawati, 2017). The process of making mushroom seeds requires the application of strict aseptic techniques. This means that all conditions in the workspace, from materials to tools to airflow, must always be sterile to prevent contamination. Before making seedlings, workers are required to clean themselves. This includes wearing clean clothes and washing your hands with soap, then cleaning your hands with 70% alcohol. During the inoculation process, the inoculation chamber must be in an aseptic condition by closing the room tightly to prevent the entry of air flow-carrying contaminants. Tools such as stirrers must be sterilized by incineration to ensure that no microbes survive. The seedling planting process must be carried out quickly to reduce the risk of contamination from the air (Widimurjani, 2016).

RESULTS AND DISCUSSIONS

Mycelial growth

The mycelial growth of the *P. pulmonarius*, *P. florida*, *Auricularia sp.*, and *S. commune* showed active growth on wheat grains and wood pellets (Table 1 and Picture 4). However, mycelial density is superior to that of wheat grains, which are used instead of wood pellets. This is due to the nutrient value content of wheat grains (Ganisan, 2011). The carbohydrate content in grains, such as starch and simple sugars, makes them an excellent substrate for the growth of fungal mycelium. These carbohydrates are easily broken down and absorbed by fungi as a source of energy for their growth and development (Nurdin & Nurdin, 2020). Furthermore, *S. commune* matured spawn earlier than *P. pulmonarius* and *P. florida* in wheat grains or wood pellets.

Mushroom growth

Wood and grain spawn were inoculated into mushroom substrate bags for mycelial growth and fruiting body formation. Among the treatments, no significant difference was observed either at the time of harvesting or the final yield of mushrooms on both wheat grains and wood pellets (Picture 5). *P. pulmonarius* was shown to have a higher final yield of mushrooms compared to *P. florida*, *Auricularia sp.*, and *S. commune*. However, as indicated before *S. commune* has a shorter incubation

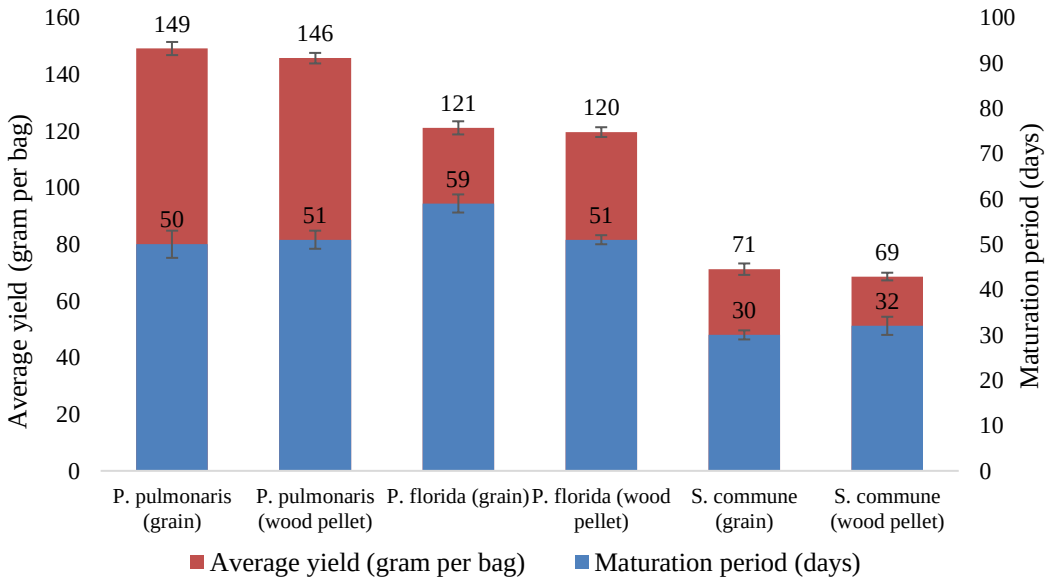
period on both *Pleurotus* and *Auricularia* species.

Table 1. Matured Spawn and Mycelial Density of Selected Edible Local Mushroom Growth in Wheat Grains and Wood

Strains	Carrier	Matured spawn (day)	Mycelial density
P. pulmonarius	Wheat grains	12	++++
	Wood pellets	18	+++
P. florida	Wheat grains	14	++++
	Wood pellets	19	+++
Auricularia sp	Wheat grains	20	+++
	Wood pellets	22	++
S. commune	Wheat grains	7	++++
	Wood pellets	12	+++

+ indicate as density of mycelial growth on wheat grains or wood pellets

Picture 4. Matured Spawn Growth either in Wood Pellets (a) or Wheat Grains (b)



Picture 5. Comparison of Selected Mushroom Yield on Wheat Grains (g) and Wood Pellets (w)

Inoculation process based on time (mins)

Both wood and wheat grain spawns were inoculated into mushroom substrate bags. Less time was consumed in the inoculation process when using wood pellets as compared to grain spawn (Table 2). Calculation cost spawn per mushroom substrate bag is shown in Table 3. According to Zulfarina *et al.* (2019). Mushroom cultivation is an appropriate technology that can provide economic benefits for the community. The process of cultivating oyster mushrooms, which is relatively simple and low-cost, can be carried out by various groups. This plant does not require chemical fertilizers and can grow all year round. The scale of oyster mushroom cultivation can be adjusted, ranging from household to industrial scales. In addition, waste from oyster mushroom cultivation has added value as organic material for compost, animal feed, and worm culture media.

Table 2. Comparison of Inoculation Process Based on Time (mins)

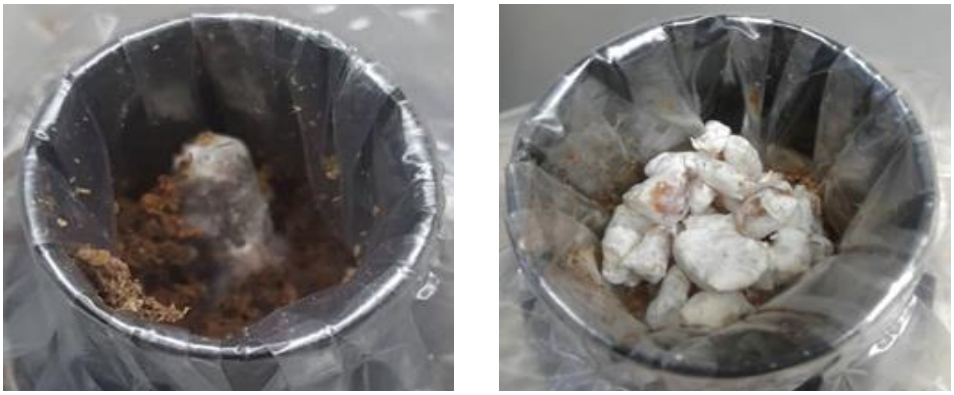
Spawn	Number of mushrooms substrate bag	Time (mins)
Wood	500	160 ± 20
Wheat grains	500	250 ± 15

Table 3. The Cost of Spawn Per Mushroom Substrate Bag

Spawn	*Price per bag	Quantity	Number of mushroom substrate bag inoculated	#Cost spawn per bag
Wheat grains	RM 3.50	350 grams	70 bag (5 grams per bag)	RM 0.05
Wood	RM 10.00	1000 units	1000 (1 pellet per bag)	RM 0.01

* The price per bag including the cost of mycelial growth depends on the material used. Ringgit Malaysia (RM)

The inoculation of wood spawn into pasteurized mushroom bag substrate is much easier and fast, relatively compared used of grain spawn (Picture 6).



Picture 6. Wood Pellets and Wheat Grains Spawn Inoculated into The Pasteurized Mushroom Substrate

CONCLUSION

Due to the uncertain and unaffordable price of grains nowadays, instead of grains, spawn can be made by using wood as a carrier. However, wood spawn technology is still rare among mushroom growers. Introducing the use of wood spawn is seen as an easy, efficient, and practical alternative for the mushroom industry.

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