

Oyster Mushroom Cultivation

Part III. Mushrooms Worldwide

Chapter 10

Regional Research

MUSHROOM CULTIVATION IN ZIMBABWE

Audrey R.S. Mabveni

University of Zimbabwe, Zimbabwe

Introduction



Figure 1. Map of Zimbabwe

Zimbabwe is located in southern Africa, surrounded by South Africa to the South, Zambia to the north, Mozambique to the East, and Botswana to the West. Its geographic co-ordinates are 20° 00'S and 30° 00'E.

The climate of Zimbabwe is moderated by the high altitude, the proximity to maritime influence from the Mozambique Channel, the influence of the mid-continental high pressure (the Botswana upper high) and the volatile, warm, moist conditions of the intertropical convergence zone (ITCZ). Three distinct seasons are discernible. The hot-dry season, which begins in mid-August and lasts up to mid-November, is followed by a warm-to-hot wet season characterized by thunderstorms from the onset of the rains in November until March and April. The cool-to-warm dry season, marked by warm sunny days, cool nights and high evapotranspiration, lasts from May to August. Humidity changes (20% in

October to an uncomfortable 80% in January) depend mainly on the season and the time of day. In most places the air temperature varies within the temperate/sub-tropical range of 10-28°C. The climatic comfort is generally optimum in most parts of the country, except during the month of October, when the whole country is extremely hot excepting the eastern highlands. The general climatic favorableness notwithstanding, the people living in the lowlands of the Zambezi and Limpopo valleys endure prolonged heat stress (Fig. 2).

The country is divided into five natural regions as follows:

- I. Natural region 1 (5,835km²)-High rainfall (900 - 1,000mm/year), specialized, diversified farming.
- II. Natural region 2 (72,745km²)
 - (a) Moderately high rainfall (750-1,000mm/year),

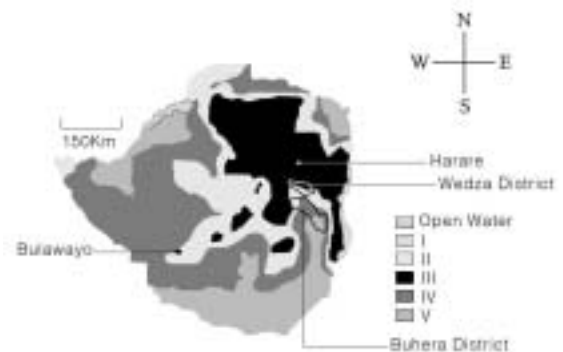


Figure 2. The natural regions of Zimbabwe and the location of Hwedza & Buhera districts

confined to summer months. Intensified farming region.

(b) Same as (a) More severe dry spells during rainy season or relatively short rainy seasons.

III. Natural region 3 (67,690km²)- Moderate rainfall (650-800mm/year), semi-intensive farming.

IV. Natural region 4 (128,370km²)- Fairly low rainfall (450-600mm/year), semi-intensive farming.

V. Natural region 5 (112,810km²)- Low and erratic rainfall (less than 650mm/year), extensive farming.

Mushroom Growing in Zimbabwe

Introduction

In the past five years interest in mushrooms greatly increased in Zimbabwe. This is mainly due to the current shortage of mushrooms on the local market, which has caused prices to escalate. Mushroom cultivation has subsequently become a highly profitable activity.

The use of mushrooms as food crosses all cultural boundaries. Mushroom consumption in Africa and especially in Zimbabwe, has deep traditional roots. Mushrooms have been gathered since time immemorial in Zimbabwe and are featured in many local dishes, medicines, and appear in culture and folklore. Many Zimbabwean traditions regard mushrooms as gifts presented to the people by their ancestral spirits in the forests. For this reason the sale of wild mushrooms is strictly forbidden in certain areas of the country.

Identified species / collections

There are over 60 species of edible species of wild mushrooms found in Zimbabwe. The majority are found in the Miombo woodlands, which cover over 60% of the country and are dominated by *Brachystegia* and *Julbernardia* tree species. Mushrooms play a very important in the dietary calendar of most resource-poor farmers. They occur soon after the first rains in November and are available until March. They are eaten fresh and the surplus is sun dried for consumption during the dry season. Mushrooms therefore assist in overcoming malnutrition among the low-income groups in Zimbabwe.

Mushroom Cultivation

Despite their popularity, culinary uses, financial appeal and primary dietary role at the smallholder level, the amount of wild mushroom gathered continues to decline due to deforestation. This realization necessitated the development of suitable small-scale mushroom cultivation. If successful, this small-scale cultivation would make them easy to get mushrooms any time and at more reasonable prices.

For the Zimbabwean smallholder farmers and resource-disadvantaged communities, mushroom cultivation enables them to have a balanced diet at a relatively inexpensive cost (Mswaka, *et al.*, 2001). Edible mushrooms rank above all vegetables and legumes (except soybeans) in protein content and have significant levels of Vitamin B and C, and are low in fat (Stamets, 1993). Mushroom cultivation also enables farmers to utilize organic substrates that would otherwise be regarded as waste products (Wood, 1985; Labuschagne, *et al.*, 2000).

Justification

A detailed socio-economic study of agriculture and horticulture in Hwedza and Buhera, commissioned by the Zimbabwe Biotechnology Advisory Committee (ZIMBAC), was done by a local non-governmental organization (NGO) called COPIBO-Zimbabwe (now VECO-Zimbabwe) in 1997. The study identified, among other constraints, a general lack of vigor among rural households. This tended to be linked to malnutrition among children. It was recommended then in the report that poverty alleviation projects had to be introduced that would address these major problems and also have an income generation component for the household. Mushroom cultivation was

identified as one of the projects that could be introduced to address the problems highlighted. It was noted that women traditionally collected mushrooms, would play a central role in mushroom cultivation without significant distraction from other activities. The ultimate goal of the project was to improve the nutrition and income of resource-poor farmers (RPFs) through oyster mushroom cultivation (Mswaka, *et al.*, 2001). The specific objectives were: 1. To assist RPFs in establishing functional mushroom growing facilities. 2. To train selected RPFs and agricultural extension officers in mushroom cultivation. 3. To produce and disseminate literature on mushroom cultivation. 4. To carry out research on the cultivation of edible mushrooms.

Hwedza and Buhera were selected as pilot districts in Zimbabwe because these districts span natural farming regions II(b) to V (Fig. 2). Results from these areas could be extrapolated to other areas with similar environmental conditions. Oyster mushrooms (*Pleurotus sajor-caju* and *P. ostreatus*) were selected by smallholder farmers because of the adaptability of the cultivation technology (Wood, 1985), and also their similarity to local indigenous mushrooms (Nzeve and Huvhe) (*Termitomycetes*). Cultivation of oyster mushrooms by the smallholder farmers would also help reduce the incidence of mushroom poisoning by providing known, well-identified edible species (Alexopoulos, *et al.*, 1979).

Oyster mushroom cultivation

Spawn supply, sources

Spawn was produced in research laboratories at the University of Zimbabwe (Department of Biological Sciences, Microbiology section) and at the Scientific and Industrial Research and Development Centre (SIRDC), Biotechnology Research Unit (BRI). Standard procedures of oyster mushroom spawn production were followed. The substrates used for the spawn were wheat (*Triticum* sp.) and sorghum (*Pennisetum* sp.) grains (Fig. 3).

Mushroom growing house (MGH)

The recommended MGH was a 8 × 6m brick and mortar structure, with cement floor, gable thatched roof with jute bags ceiling. The building was to have screened (wire gauze) windows on all four sides, with 2 windows on one of the longer sides and a door between the windows on the other longer side. Double doors were recommended, with the outer door being a screen door (Fig. 4). At the selected sites, resources (money) were provided to acquire bricks, cement, window and door frames and pay the builders. The community was to provide all the other resources necessary to complete the mushroom growing houses. A MGH ready for use was to have the floor covered with river sand up to a depth of 2cm.

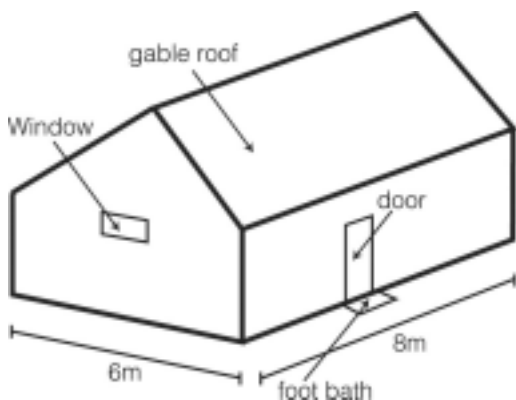


Figure 4. Structure of recommended oyster mushroom growing house



Figure 3. Mushroom spawn incubator at the University of Zimbabwe

At the eleven sites, the participants modified the gabled roof to a flat roof (Fig. 5), because the recommended roof type was expensive to put up. The flat roof had its own drawbacks. All the roofs collapsed inwards within the first year, and the participants had to repair the roofs. This collapse also tended to damage the walls of the MGH, which had to be periodically repaired. At one of the sites, the size of the MGH was reduced because it was a family unit and there was a limitation on labour to work in.

At all the adopter sites, the MGH was modified in various ways. At some sites, the structure was made of grass, with a lining of plastic sheeting inside (Fig. 6). Generally, the size of

the MGH was reduced to $4 \times 3\text{m}$, with a flat roof. At another site, the walls of the mushroom house were made of pole and dagga, with a flat thatched roof.



Figure 5. Recommended MGH a flat thatched roof



Figure 6. Mushroom growing house made of grass



A. Traditional kitchen



B. Partitioned structure

Figure 7. Modified structures into MGH

Other adopters modified already existing structures into mushroom growing houses. In some cases, traditional kitchens (round huts) were renovated and modified into mushroom houses (Fig. 7a). In other cases, existing structures in the homestead were partitioned and modified into mushroom houses (Fig. 7b).

Various reasons were given for the modifications observed. Generally, it was noted that the $8 \times 6\text{m}$ MGH was too big to be maintained by a family unit. The gabled roof was too expensive to put up, though it was easier to maintain than the flat roof. The flat roof was cheap to put up, difficult to maintain and had to be replaced every year. However, on the smaller MGH, the flat roof was considered ideal.

Labour to work on the mushroom house was family-based. The work involved the construction of the MGH, laying of sand for the floor, collection and processing of the substrate and spawning, and watering of the mushroom house at least once a day. With the family as the labour source, all adopter sites constructed smaller mushroom houses. The source of water and the distance between the water source and the MGH were very important factors that determined the location and the size of the MGH.

Where resources were very limited, the family modified disused structures in the homestead. These included round huts and partitioned structures in the already existing buildings. Resources were then channeled into acquiring the spawn and plastic tubing, which were needed to grow the mushroom.

Uses of naturally available materials were demonstrated in MGHs that were constructed utilizing thatch grass, pole and dagga. These materials are readily available, especially after the rainy season, and are normally free. One just has to have the labour to cut and collect.

Substrates

While the recommended substrates were used, the farmers showed preferences for a particular type of substrate and they also tended to use materials that were readily available and also considered the amount of time and energy



Figure 8. Chopping substrate (banana leaves)

spent in collecting and processing the substrate (Fig. 8).

Gondya was a favorite substrate when available. This type of grass was easily collected in river valleys, and grows in very large mats. It gets soft when soaked in water, as a result is very easy to manipulate. Banana fronds, when available were also a preferred substrate, because they are soft when soaked in water and also readily available because bananas are normally grown near homesteads. Mowed lawn was also preferred because no further processing was required after collecting. In maize and wheat growing areas, residues from these crops were used as the mushroom substrates. Thatch grass grows quite well during the rainy season, and it was also used as substrate on its own or was mixed with maize stover or

groundnut shells.



Figure 9. Women filling mushroom growing bags with chopped and pasteurized banana fronds

Growing conditions



Figure 10. River sand covering the floor of a mushroom growing house. Notice the black plastic sheeting covering the grass walls, to prevent water loss

Moisture and temperature are important factors that had to be monitored in the MGH. River-sand on the floor of the MGH was used to maintain high humidity in the MGH (Fig. 10). Clean water was periodically sprayed on the mushroom growing bags, especially during fruiting.

Those farmers who had readily available water flooded the cement floor, without the sand (Fig. 11). In the thatch grass MGH, the walls were lined with plastic sheeting to prevent excessive water loss through the grass walls (Fig. 10). With the soil rammed floors, the floor was also covered with plastic before river sand was added. This prevented excessive seepage into the ground. Where resources were limited, instead of buying a new hand sprayer for the MGH, new traditional hand brooms were recommended. These would be dipped in clean water and used to spray the bags.

Black or white plastic tubing could be used as mushroom growing bags (Fig. 12, 13). Some farmers preferred the white tubing as this allowed them to monitor activities in the mushroom bag. Others



Figure 11. Mushroom house floor without sand. Water flooded onto the floor directly

preferred the black pockets because they reduced the need to close up the MGH during the first 4 weeks when no light is required in the MGH.

Harvesting and marketing

Oyster mushroom pinheads normally appear 5-6 weeks through the punched holes (Fig. 14) after the substrate has been fully colonized by the oyster mushroom mycelium (Fig. 13). The bags are periodically sprayed with clean water to avoid the drying of the mushroom pinheads. Within 3-5 days the mushroom fruiting bodies will be ready for harvesting (Fig. 15), and the size at harvesting is dependent on the market demands.



Figure 12. Mushroom growing bags (black), hanging on wooden beams, with distinct mushroom pinheads showing after 5 weeks of incubation (spawn run)



Figure 13. fully colonized clear/transparent mushroom bags. Before holes are punched. This is after the 4 to 5 weeks incubation period



Figure 14. Young fruitbodies on the bag



Figure 15. Oyster mushroom ready for harvesting: size at harvesting is dependent on the market demands

Economics of oyster mushroom production

(a) Growing bags: can be obtained from

- (i) Farm and City at ZWD*350.00 per metre. These are narrower and not as strong as the ones used in the project.
- (ii) Ecoplastics and Proplastics. The Project buys from either. Their prices are the same. The minimum quantity that they sell is 300kg, currently at ZWD7,000.00 per kg (ZWD2.1 million for 12 rolls). Each roll is approximately 175m long. The cost works out at roughly ZWD1,000.00 per metre or ZWD175,000.00 per roll.

(b) Spawn: The actual cost of production is ZWD9,400.00 per kg, but currently sold to project farmers and adopters at ZWD3,000.00 per kg.

1kg of mushroom spawn seeds 5 bags, each 1 metre long. Each bag takes about 10kg of dry substrate. The biological efficiency of oyster mushrooms is about 100%, that is, for every kg dry weight of substrate the yield of

mushroom is 1kg. Therefore you can expect to get 10kg mushroom from each bag in total (throughout the entire harvest period), provided all production procedures are optimized. With 1kg of spawn and 5×10kg substrate, 50kg of mushroom will be produced in a crop.

Production cost for 5 bags = ZWD32,000

Material: spawn (ZWD3,000) + bag (5m×ZWD1,000 = ZWD5,000) = ZWD8,000

Labour: estimated at ZWD8,000 × 3 = ZWD24,000

Sales income for 5 bags = ZWD5,000.00/kg × 50kg = ZWD250,000.00

Net income for 1 bag = (ZWD250,000.00 - ZWD32,000) / 5 = ZWD43,600 (USD53)

Remember that this profit is spread over the mushroom production cycle of 3-4 months. The more bags you have in a production cycle, the more mushrooms they will produce and the higher the profit levels will be.

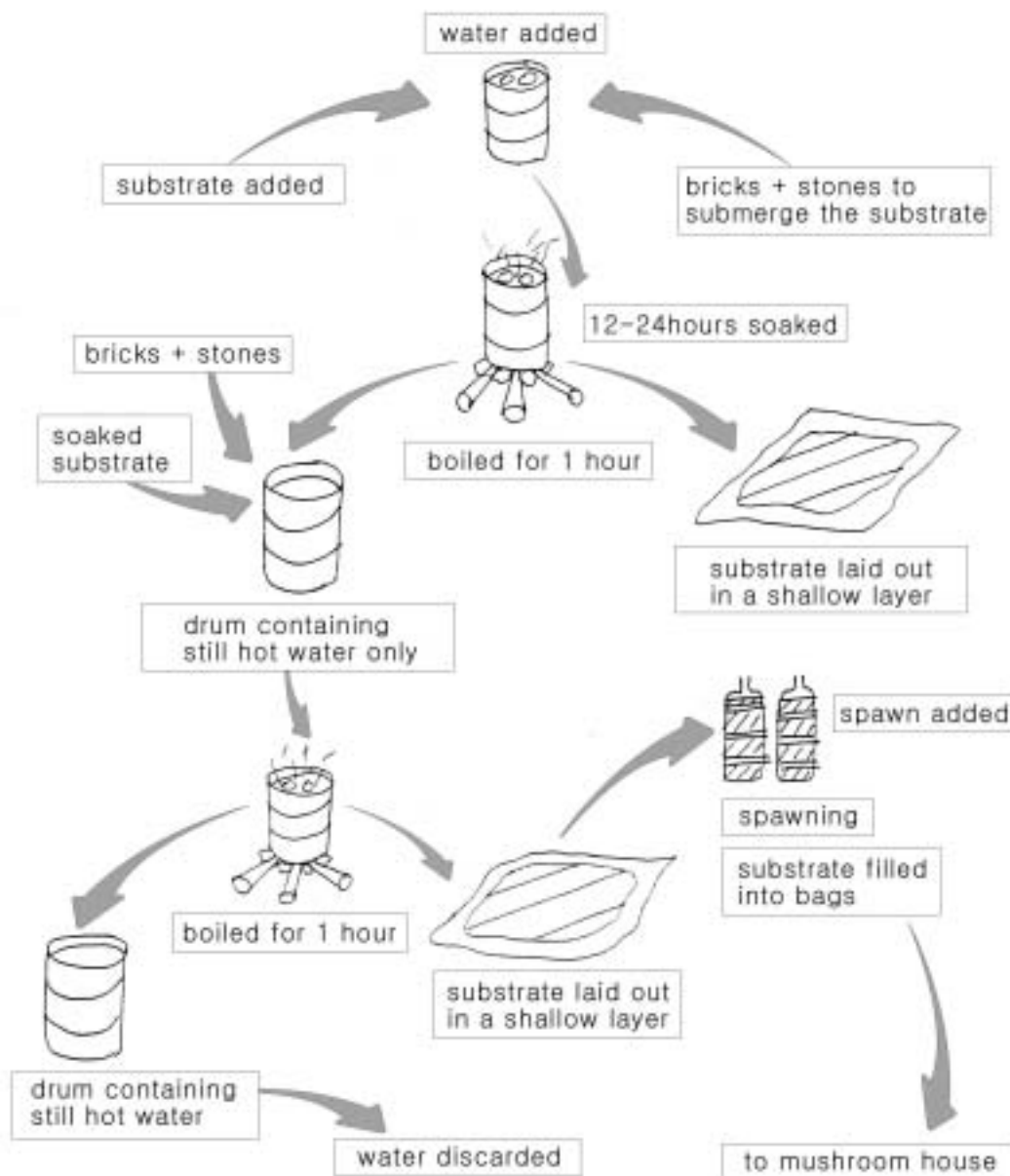


Figure 16. Diagrammatic presentation of oyster mushroom cultivation from substrate preparation to hanging bags in mushroom growing house

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