HARNESSING DIGITAL AGRICULTURE TECHNOLOGIES FOR SMALLHOLDER FARMERS IN LAO PDR

E-extension for Agriculture Project

E-learning Module

TECHNIQUES OF INDOOR AND OUTDOOR RICE STRAW MUSHROOM CULTIVATION

CABIN

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Objective of the lesson

At the end of this training course, students or participants will be able to:

- Understand and master the steps of indoor and outdoor straw mushroom cultivation process
- Practice indoor and outdoor straw mushroom cultivation techniques at local level

The contents

1. RICE STRAW MUSHROOM

- Straw is a byproduct of rice production. The high cost of straw collection, low selling price of raw straw, lack of sustainable straw management, and limited business models to increase the value of straw contribute to the increasing prevalence of open-field straw burning.

- To minimize the harmful effects of straw open-field burning and incorporation, there is a focus on developing straw collection technology and promoting business models for straw products as a circular economy solution based on straw. A prime example is the cultivation of straw mushrooms, which aims to increase income, enhance the straw value chain, and contribute to changing the production mindset of farmers and stakeholders in the value chain.

- Two main practices for rice straw mushroom cultivation:

1) Outdoor cultivation has an average yield of about 80 - 100 kg of mushroom/1 ton of straw, and 2) indoor cultivation can control a part of condition growing with an average yield of about 150-200kg of mushrooms/ton of straw.

2. Techniques for outdoor mushroom cultivation

Step 1 : Preparing the growing location

- Straw mushrooms can be cultivated in shade or direct light locations, such as on field ground or seedbed ground. The chosen grown site must have good drainage to manage watering or rainfall effectively.
- The soil for cultivating straw mushrooms should be treated with lime at a rate of 5 kg/100 m2 (or 300-500 kg/ha)

Cultivation under the shade

Treatment with the burnt lime

Field ground or seedbed ground

Step 2: Preparing rice straw

The straw source can be in bale loose form. The straw source must be disease-free, not affected by pesticides, not contaminated with salinity and white mold, and not rotten due to rain.

Straw from bale

Straw from bale

Step 3: Preparing rice straw

- Prepare the ground to place the compost pile, in a well-ventilated, well-drained place.
- Location with a proactive water source
- The bale of rice straw are split in half, or separated from the bale of rice straw.

Step 4: Stacking and turning

- Stack the straw into layers and alternative with burned lime
- Water to add moisture to the compost pile
- Place banana trees in the middle of the compost pile to create ventilation for the compost pile
- The amount of straw used is ≥ 100kg, the size of the compost pile is about 1.2 - 1.5m high, about ≥ 1.5m wide and can be more than 1.5m long.
- Use waterproof tarpaulin to cover the compost pile, there should be ventilation holes on the compost pile.

Stack the straw in layers

Spread a thin layer of burned lime alternating with a layer of straw

Stack the straw and water to add moisture.

Use a tarpaulin to cover the compost pile

Step 4: Stacking and turning

- Monitor humidity levels and add water as necessary, ensuring the temperature remains 60 - 70°C.
- After 7 and 17 days of composting, turn the pile for the first and second times, rotating from the inside out and from the outside in.

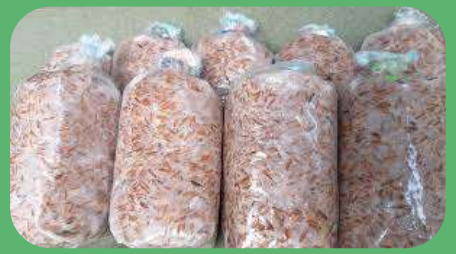
Manual checking the moisture

Turning the compost pile

Step 5: Preparing the mushroom spawn

- The spawn is rice husk spawn, so choose bags of spawn with evenly white silk and a pleasant smell.
- The spawn is separated and mixed with mycelium stimulating yeast at the recommended ratio. Or mix with vermicompost, dose of 70-160g and mushroom mycelium stimulating ingredients as recommended.

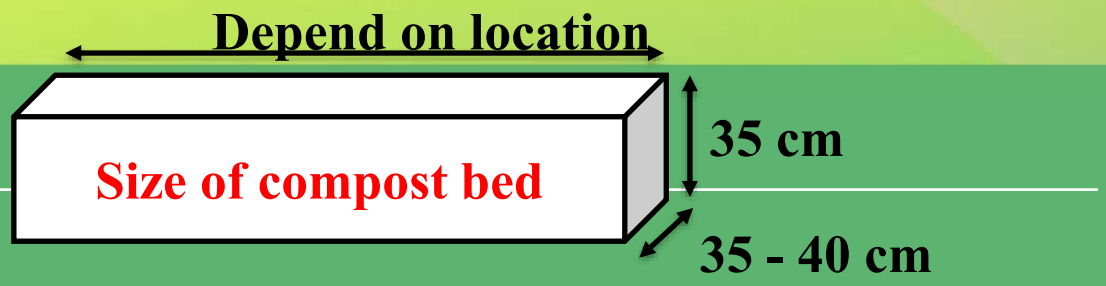
Stimulate yeast



The spawn

Separate and mix well

Step 6: Putting compost in bed



- After composting for 16-18 days, the compost is placed in a bed. The size of the compost bed should be 35-40 cm wide and 35 cm high. Straw is taken from the compost pile, rolled, and arranged into lines.
- Following this, a layer of spawn is spread in the middle of the line (approximately 160g/m of line).
- Then the surface is covered with another layer of straw.
- The compost bed is then prepared and watered. Using both hands, the compost bed is stroked and tightly compressed. Subsequently, the compost bed is exposed to direct sunlight for 4 days.

Roll straw and arrange into lines

Spread the spawn (approximately 160g/m of line

Cover on the surface by straw

Watering the compost bed

Strok and tightly compress

Dry under the sun for 4 days

Step 6: Putting compost in bed

Caution: Using the tarpaulin cover the compost bed is used in the rain; make sure the ventilation is good. Incase it is windy arrange the compost line to avoid the direct wind, the wind flow at the head of the bed.

Cover with tarpaulin on a raining day

Keep the compost bed to avoid the flow of wind

Step 7: Caring and watering

- After drying in the sun, the bed should be covered with straw, then the cover should be wetted.
- Watering once a day, either in the afternoon at about 4 pm or in the morning (7-8 am), should be done using a shower.

Cover with straw

Watering by the shower

Step 7: Caring and watering

- After covering the straw for 4 or 5 days, check the spread of mycelium and turn the bed cover to limit the mycelium spreading beyond the cover layer.
- On the 7th or 8th day, when the mycelium spreads evenly, begin watering for mushroom growth. About 2 days later, the pins will start appearing.

Mycelium spreading beyond the cover layer

Appearing pins

Step 8: Harvesting

- The time from sowing spawn to harvesting is about 12 days. Harvest twice a day, in the morning (at 5-6 am) and in the afternoon (at 17-18 pm).
- There are 2 harvests. The 1st harvest is within 4 days. Afterwards, take care of the mushroom bed, and approximately 5-6 days later, the mushrooms will appear.
- How to harvest mushrooms: Gently rotate the mushroom to separate it from the compost bed. Do not leave the mushroom feet on the compost bed, because the mushroom feet will rot and damage the affected mushroom buds. After harvesting, cover the compost bed.

Group of rice straw mushroom

Harvest mushroom

Step 9: Cleaning after mushrooms cultivation

- After harvesting the mushrooms, the substrate can be composted to create organic fertilizer for plants.
- Use burnt lime to disinfect the growing area and leave it in the sun for at least 1 month before growing the next crop.

Collect the left-over of rice straw mushroom, treat the ground with burnt lime

Utilize for production of rice straw compost

The rice straw substrate product

2. Techniques for indoor mushroom cultivation

Step 1: Preparing net house and shelves

- The net house (dimensions are approximately 3m high and 4.5m wide, with a length of around 8m, or a size varying depending on actual conditions.
- Covered with waterproof tarpaulin, and inside, an orchid net or wire net can be used. The temperature and humidity inside the net house can be regulated. It is crucial to ensure ventilation in the net house.
- Growing shelves, comprised of bamboo or iron, have 3-4 floors spaced 0.5m apart to allow for convenient movement

Iron shelves

Bamboo shelves

Kind of net house

Step 1: Preparing net house and shelves

- Growing shelves, comprised of bamboo or iron, have 3-4 floors spaced 0.5m apart to allow for convenient movement

Space from floor to floor 0.5 m

Step 2: Preparing rice straw

Straw must be selected that is new and disease-free or not rot. In addition, it is necessary to determine that the straw has not been contaminated with salt or pesticides before. Use a bale of straw weighing about 14-6 kg or piles of straw.

Straw from bale

Straw from bile

Step 3: Soaking of straw

- Prepare a straw soaking tank, placing it near the composting area for convenience.
- Use waterproof tarpaulin to construct the soaking tank with the size depending on actual conditions.
- The ground for the tank must be flat, without sharp trees or objects that could tear the walls of the tank.

Step 3: Straw treatment

- Prepare lime water: Add water, to about 20cm high, then add lime. Stir well and use pH paper to test (aiming for a pH of 13-14). Usually, about 5 kg of lime should be added to 1 m^3 of water

Soak straw

- After soaking the straw for approximately 10 minutes, remove and drain it. The straw will appear bright yellow after being soaked in lime water.

Remove and drain

Step 4: Stacking and turning

- Arrange the straw in layers, placing a banana plant in the middle, watering, and compressing it with the foot to soften and absorb water (each layer should be 20-30 cm thick). Additionally, sprinkle an extra layer of lime to eliminate other fungi. Remove stalks or debris from the watered straw .
- Continue stacking layers until the compost pile reaches the desired size (the amount of raw straw to be used is at least 1 ton to ensure that the size of the compost bed is about 1.2 - 1.5 m high, about ≥1.5m wide, and 1.5 m long or can be increased depending on the amount of straw). Remove plants from the middle of the pile to create more space. Ensure ventilation of the compost pile and cover it with a waterproof tarp to maintain moisture and heat.

Cover the compost pil by waterproof tarpaulin

Watering the compost pile

Step 4: Stacking and turning

- After 7 days, perform the first turning of the compost pile (from outside to inside and from inside to outside). Add water if there is a lack of moisture and compact the compost pile (if there is excess water, compacting is not necessary). The humidity level must reach 70-75%, and the temperature should be above 70°C.
- After 10 days, perform the second turning. After 17 days of incubation, the straw can be utilized for growing mushrooms.

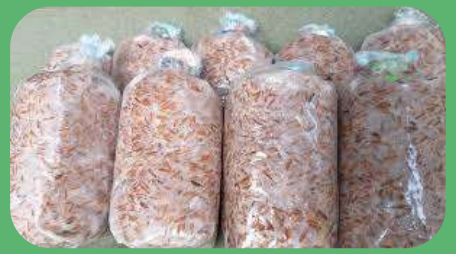
Manual checking the moisture

Turning the compost pile

Step 5: Preparing mushroom spawn

- The mushroom spawn is rice husk spawn, so choose bags of spawn with evenly white silk and a pleasant smell.
- The spawn is separated and mixed with mycelium stimulating yeast at the recommended ratio.

Stimulate yeast



The mushroom spawn

Separate and mix well

Step 6: Putting compost straw on shelves

Straw is put on the shelves in the growing house, the straw is separated and put on the shelves. Just fold it up and compress it

Mix separating mushroom spawn with yeast to stimulate growth and supplement nutrition, spread the mushroom spawn evenly on the surface with a dose of 200 g/m2

Growing shelves

Step 6: Putting compost straw on shelves

- Incubate the mycelium within 3 days, check the humidity and temperature in the net house regularly, to control water spraying and open the net house for
- After 3 days, apply vermi-compost fertilizer, dose 2 kg/m^2

Apply vermi-compost fertilizer

Step 7: Caring and watering

- During the incubation period, it is essential to monitor the temperature and humidity of the net house
- The suitable temperature for the mycelium stage is 15-40°C, with humidity maintained at 50-70%
- For the fruiting stage, the temperature should be 25-30°C, with humidity between 80-100%.
- At this stage, the substrate does not require abundant moisture. If the temperature is high and the humidity is low, spraying mist in the net house is recommended.

Monitor the net house with a hygrometer and thermometer

Spraying mist in the net house

Step 7: Caring and watering

- After 7 days, ample water should be sprinkled to stimulate the mycelium to form fruiting bodies. When spraying water, it should be combined with lighting for 12 hours to aid in simultaneous fruit body formation
- Additionally, 0.05% sodium acetate (1 L/m2) can be added to promote better mushroom growth.

Spraying mist in the net house

Appearing pins

Step 8: Harvesting

- Harvest straw mushrooms at the egg-shaped stage. Harvesting should be done twice a day, in the morning (5 - 6 am) and in the afternoon (5 pm - 6 pm), to ensure quality, productivity, and a high selling price.
- There are 2 harvests. The first harvest should be made within 4 days. Then, continue to care for the mushrooms as before for about 5-6 days, and the new mushrooms will begin to appear. The harvest will last about 3 days

Rice straw mushroom in the harvesting

Step 9: Cleaning the net house

- After harvesting the mushrooms, the substrate can be composted as organic fertilizer to nourish plants
- Open the tarpaulin to ventilate the net house and use lime to eliminate bacteria. Quarantine the area for at least 1 month before planting the next crop

Collect rice straw left-over, remove the tarpaulin, Treat the ground with burnt lime

Utilize for production rice straw compost

Rice straw compost product

VIDEO FOR INDOOR AND OUTDOOR RICE STRAW MUSHROOM CULTIVATION

THANK YOU!!!