

6.9. MUSHROOM CULTIVATION

Mushroom cultivation or mushroom farming, whatever you call, is now a days a source of earnings to common people for two reasons: 1. Low investment and 2. High demand for mushrooms in the food sector. The mushrooms have been revered in Eastern cultures for thousand years due to their health benefits as they are the source of many nutrients. Now-a-days mushrooms are considered as a high quality food because of its zero fat contents and high mineral contents along with essential vitamins.

Often grouped with vegetables, mushrooms provide many of the nutritional attributes found in meat, beans or grains. Nutritionally these are low in calories, fat free, cholesterol free, gluten free, low in sodium but provide selenium, potassium, riboflavin, niacin, vitamin D and many more essential requirements when taken as a food. This necessitated the demand for mushrooms everywhere in the world and due to this mushroom cultivation is an alluring business.

Cultivation of button mushroom (*Agaricus bisporus*) started in 16th century but cultivation in commercial scale was initiated in Europe around 17th century.

I. CULTIVATED MUSHROOMS

There are nearly 2000 species of mushrooms which are edible all over the world. Amongst them there are 300 species found in India. The edible mushrooms found in nature can be grouped into five categories on the basis of the abilities to colonise the natural substrates. The five categories are:

- I. Grow on fresh plant residues: Examples: *Pleurotus*, *Lentinus*, *Flammulina*, *Auricularia*, *Pholiota*, *Tremelia*.
- II. Grow on very little compost residues: Examples: *Votrariella*, *Stropharia*, *Coprinus*.
- III. Grow on fairly decomposed materials: *Agaricus*.
- IV. Grow on soil and humus: *Morchella* (an Ascomycetes), *Gyromitra*, *Lepiota*, *Lepista*.
- V. Grow as Mycorrhizae: *Boletus*, *Amanita*, *Tuber*, *Lactarius*, *Tricholoma*, *Tuber*.

Most of the edible mushrooms belong to Basidiomycota phylum. However, around 20 genera of mushrooms have been used for cultivation in the world out of which 3 genera have been preferred or advised for cultivation in India. These cultivated mushroom genera are *Agaricus*, *Volvariella* and *Pleurotus*. *Agaricus bisporus* (called as **button mushroom**), *Volvariella volvacea* (called as **straw mushroom**) and *Pleurotus sajor cajn* (called as **oyster mushrooms**) are cultivated in commercial scales.

The method described here deals with the cultivation of button mushrooms (*A. bisporus*).

II. PRODUCTION TECHNOLOGY

In India this button mushroom is grown seasonally and in environment controlled cropping houses. White button mushroom requires 20-28°C for vegetative growth and 12-18°C for reproductive growth. It requires a relative humidity of 80-90% and enough ventilation during cropping.

In north-west plains of India it grows in winter months and for 8-10 months in a year on the hills. However, due to the development of modern cultivation technology, mushroom can now be cultivated anywhere in India at any time.

The major mushroom producing states in India are Himachal Pradesh, Uttar Pradesh, Punjab, Haryana, Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka.

The process of mushroom cultivation involves the following steps:

- A. Spawn production
- B. Compost preparation
- C. Spawning
- D. Casing
- E. Fruiting and preservation.

A. Spawn Production

Spawn is the pure variety of the mushroom vegetative hyphae (mostly the primary mycelia). It is produced from the fruiting culture or the stocks of the selected strains of the mushroom under sterile conditions.

The quality, flavour, size, texture of the mushroom depend on the spawn quality and purity. Spawns are produced in the agricultural research laboratories, universities also and sold in market at subsidized rates by the government shops. Stock cultures are either produced in the lab or obtained from reputed source.

The objective is to provide a high potential spawn for good yield and longer self life.

B. Compost Preparation

Compost is the substrate on which the mushrooms are cultivated. The quality of the compost determines the yield.

Compost is generally prepared from a mixture of plant wastes (straw of cereals/sugarcane bagasses etc.), salts (urea, sugar phosphates/gypsum etc.), supplements (rice bran/wheat bran) and water. This is a synthetic compost. The compost can also be natural with use of horse dung.

To yield 1 kg of mushroom 220 g of dry substrate is required. The standard composition of one ton of compost has nitrogen 6.6 kg, phosphates 2.2 kg, potassium 5.6 kg which would get converted 1.98% N, 0.62% P, and 1.5% K on a dry weight basis. The ratio of C : N should be 25-30 : 1 at the time of stacking and 16-17 : 1 the final compost. It is recommended that for 15-16 trays of size 1 m x 1/2 m x 15 cm the components required for the compost are:

Wheat straw (chopped to 8-20 cm)	-	250 kg
Wheat/rice bran	-	20 kg
Ammonium sulphate/calcium ammonium nitrate	-	3 kg
Urea	-	3 kg
Gypsum	-	20 kg
Molasses	-	10 kg

(60 or 60 kg of chicken manure can be used if available).

There are two methods of composting

1. Short method of composting
2. Long method of composting.

1. Short Method of Composting

In this method paddy straw is used. The straw is sufficiently watered to keep it wet and the components as mentioned are mixed thoroughly with straw. The straw is then stacked in 5' x 5' size or in any convenient size.

The stack is turned and different treatments are given at every turning as per the following schedule:

- (a) 2nd day - 1st turning - Water is added sufficiently.
- (b) 4th day - 2nd turning - Gypsum is added and sufficient water.
- (c) 12th day - 3rd and final turning - Colour of the compost becomes brown and ammonia smell comes out.

The second phase of it is the **pasteurization phase**. It is carried out inside a steaming room where an air temperature of 60°C is maintained for 4 hours. This is done to kill undesired microbes and competitors and to convert ammonia into microbial protein. After this the substrate is cooled to 25°C.

The compost obtained after this stage is granular, contains 70% moisture and has pH 7.5. It is dark brown in colour, and without any smell of ammonia, insects and nematodes. This is now ready for spawning.

2. Long Method of Composting

This method is followed where steam pasteurization facility is not available. There are several turnings as per the following schedule.

- | | | | | |
|--|---|-------------|---|----------------------------------|
| (i) 6th day after the preparation of substrate | - | 1st turning | - | watering |
| (ii) 10th day | - | 2nd turning | - | watering |
| (iii) 13th day | - | 3rd turning | - | gypsum is added |
| (iv) 16th day | - | 4th turning | | |
| (v) 19th day | - | 5th turning | | |
| (vi) 22nd day | - | 6th turning | - | |
| (vii) 25th day | - | 7th turning | - | Malathione or BHC is added (10%) |
| (viii) 28th day | - | 8th turning | - | Checked for any ammonia smell |

The compost is to be watered at every turning and also at intervals to maintain moisture content. If the compost gives out ammonia smell, then some more turnings are required.

The compost is now ready for spawning.

C. Spawning

Spawning is the mixing of spawn with the compost. It is done in several ways:

- (i) **Spot spawning:** In this method, lumps of the spawn are planted in 5 cm deep holes made in the compost at a distance of 20-25 cm. The holes are covered by compost.
- (ii) **Surface spawning:** The spawn is spread evenly at the top layer of the compost and then mixed to a depth of 3.5 cm. The top portion is covered with a thin layer of compost.
- (iii) **Layer spawning:** 3-4 layers of spawn mixed with compost are prepared which is again covered with a thin layer of compost.

The mixing dose of spawn is 7.5 ml per 1 kg of compost or 500 to 750 g/100 kg of compost.

D. Spawn Running

In this process the spawns grow to mycelial forms inside the compost and colonise the compost entirely.

For this, the compost is either kept in polythene bags (90 × 90 cm) at 20-25 kg per bag or kept in wood in trays (1 × 1/2 m) to contain 20-30 kg or in wooden shelves.

The fungal bodies grow out and take about 12-14 days to colonise the compost. The temperature is to be maintained at $23 \pm 2^\circ\text{C}$ and the relative humidity be at 90%. Higher temperature is detrimental.

E. Casing

After spawn running process, the compost beds should be covered with a layer of soil of about 3-4 cm thick to induce fruiting. The casing material must be highly porous with high water holding capacity.

Peat moss is best for casing but not available plenty. So the mixture of garden loam soil and sand (4 : 1), decomposed cow dung and loam soil (1 : 1) and spent compost, sand and lime are used.

However, before application the casing must be pasteurized at 66-70°C for 6 hours before 15 days of its use.

After casing is done, the room temperature should be maintained at 23-28°C at relative humidity 85-90% for 8-10 days.

✓ F. Fruiting, Harvesting and Preservation

Under favourable conditions of temperature and humidity, fruiting body initials appear in the form of pin heads and they gradually develop to button stage.

Harvesting is done at button stage. The first crop appears about 3 weeks after casing. The caps measuring 2.5-4 cm sizes are harvested. Mushrooms must be harvested by light twisting without disturbing the casing soil. Once the harvesting is completed the gaps must be covered with fresh sterilized casing materials.

Nearly 10-14 kg of fresh mushrooms are obtained per 100 kg of fresh compost in two months crop.

Short method of compost preparation gives more yields.

Storage: Storage of mushrooms is most important or else they will be damaged and not saleable as they are highly perishable.

Harvested mushrooms are to be washed in a solution of 5 g KMS in 10 L of water to remove soil particles and to induce whiteness. After removing excess water, these are packed in perforated polybags and are to be kept at 4-5°C for a period of 4-5 days.

This is the main procedure as suggested by National Centre for Mushroom, Chambaghat, Solan (HP).

The crop is susceptible to diseases like dry bubble (brown spots), wet bubbles (white mould), cobweb, green mould, bacterial blotch etc. So professional helps can be taken for this and for a successful mushroom cultivation.

Government of India and as well as the states are encouraging young entrepreneurs for mushroom cultivation and providing subsidies on loans, and technical know-hows for the purpose. India is now one of the leading mushroom export countries.