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3

CULTIVATION OF BUTTON MUSHROOM

You have learnt in the previous lessons that there are various types of edible mushrooms. You are also aware that in our country button mushroom is the most popular edible mushroom and it accounts for about 3/4th of the total mushroom production in our country. We have learnt in the first lesson that this mushroom is cultivated seasonally during winters particularly in hilly regions of the country and plains of North India; and also throughout the years in commercial units spread in all parts of the country.

Cultivation of this mushroom requires good knowledge of preparation of compost and crop management practices. The compost is a selective material on which the desired mushroom has better growth. We also need good understanding of manipulation of environmental conditions like carbon dioxide content, temperature and humidity during cropping.

Cultivation of this mushroom started in France in 1650s but the scientific cultivation started only in last century when techniques for preparation of pure culture (1900), grain spawn (1932) and good quality compost (1950s) were standardized. Cultivation started picking up after World War II and till the beginning of 21st century button mushroom was number one mushroom in terms of production. In USA, Europe and Australia even today this is the most popular mushroom and in fact when we say mushroom, many people think of only button mushroom. In this chapter we will discuss different steps of button mushroom cultivation in detail.

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OBJECTIVES

After reading this lesson you will be able to:

- identify and select the appropriate type of materials required for making compost for button mushrooms;
- select the ingredients and make compost using different methods;
- pasteurise the compost to make it more suitable for cultivation of button mushroom;
- identify and manage different environmental parameters during cultivation of button mushroom.

3.1 COMPOST FOR BUTTON MUSHROOM - INGREDIENTS AND FORMULATIONS

We can prepare compost by two methods - **Long method and short method**. Long method is an old and a single phase method and takes about a month. Short method is two phase method, that is, part of compost is made outside (Phase-I) and rest of the compositing is done inside specially made structures called tunnels (Phase-II). Today long method of compositing is in use in very few places in the world. In India, especially in Northern parts this is commonly followed however, majority of farmers are still making compost by this method. Let us know about the ingredients.

Ingredients: The compost is prepared by using straws, manure, gypsum, etc. In the early days horse manure was the most commonly used substrate (base material). Compost made using horse manure is normally referred as natural compost. These days compost is mainly prepared using wheat straw (1000 kg), chicken manure (500 kg), and gypsum (35 kg), Urea-18 kg. Such compost is called semi-synthetic compost.

Formulations: There are numerous formulations available. Essentially, we need a carbohydrate material (carbon source) that is provided by wheat, paddy or any other cereal straw, or by sugarcane bagasse, sugarcane leaves, mustard stalks, soybean straw, corn cobs or any other cellulosic waste.

We also need a nitrogen source like chicken manure/wheat bran, brewer's grains, various bran/cakes or fertilizers. Gypsum is invariably added to obtain the right texture and pH. Growers should avoid the use of chicken manure if compost is to be made using long method of composting as it is source of many diseases and instead of this wheat bran should be used.

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Formulations vary from place to place depending upon the raw materials available and method of compost preparation. The nitrogen content is balanced using urea, ammonium fertilizers, etc. To initiate a composting process and to minimize the loss of dry matter during composting, 1.5-1.75 percent nitrogen is generally kept in the compounding mixture. At stacking C:N ratio is adjusted to 25-30:1, which comes down to 16-20:1 after composting. Some of the commonly used formulations are as below:

FORMULA – 1 (for short method)

Wheat straw	1000 kg
Wheat bran	250 kg
Chicken manure	300 kg
Urea	18 kg
Gypsum	35 kg

FORMULA-2

Horse manure	1000 kg
Wheat straw	500 kg
Chicken manure	900 kg
Urea	15 kg
Brewer's grain	100 kg
Gypsum	150 kg

FORMULA-3 (for long method)

Wheat/rice straw	1000 kg
Urea	15 kg
CAN	20 kg
Super phosphate	10 kg
Murat of Potash	10 kg
Wheat bran	60 kg
Molasses	15 kg
Gypsum	100 kg

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How to Calculate N Content of Mixture

You have seen that we need specific nitrogen content in our mixture of ingredients before starting the preparation of compost. For this it is necessary to know the N content of different materials, their moisture content and quantity proposed to be added. Firstly we convert the value of raw materials into dry weight and then multiply the dry weight with N content to work out the N available in that material. Thereafter, we add the dry weight of the materials and the N available in these materials and directly work out the N percent as can be seen in the table 3.1.

Table 3.1: Nitrogen computation guidelines

Ingredients	Fresh wt (kg)	Moisture (%)*	Dry wt (kg) (Fresh wt × (100 – moisture %)/100	% N	N (kg) (Dry wt × % N)/100
Wheat straw	1000	10	900	0.5	4.5
Wheat bran	50	10	45	2	0.9
Chicken manure	600	10	540	2.6	14.0
Urea**	20	0	20	46	9.2
Gypsum	100	10	90	0	0
TOTAL	-	-	1595	-	28.6

N% = (28.6/1595) × 100) =1.79%

* Moisture used here is only an estimate. Actual moisture content may be calculated by drying ingredients in oven. Moisture in chicken manure can be up to 30 %

** Nitrogen content of chicken manure can vary from 2-4% and quantity of urea is adjusted to obtain N content around 1.7%

INTEXT QUESTIONS 3.1

State True or False

(i) Long method of compositing is single phase system.

(ii) Long method of compositing is better than short method of compositing.

(iii) Compost made using horse manure is normally referred as natural compost.

(iv) Nitrogen content at the start of compositing should be 1.5 to 1.75%.

(v) Chicken manure is a source of Nitrogen in the compost.

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3.2 LONG METHOD OF COMPOSITING

The compost in the early days was prepared by long method. In this method compost is made in single phase, the ingredients are wetted to obtain about 70 percent moisture, a pile about 5-6 feet wide and 5 feet high is made and it is turned inside out at regular intervals of 3-4 days. The whole process takes about 28 days. This is an aerobic process (degradation in presence of oxygen) and during early turnings lot of ammonia is produced. At the final stage, the color of compost is brown, moisture content is around 67 percent and pH is around 7.0-7.8. The compost made by this process takes lot of time, gives poor yields and is affected by number of diseases.

Steps in Making Compost by Long Method

Let us know the steps for making compost by long method. We may use this method for learning purposes or for cultivation at small scale in areas where facilities for short method of composting are not available. Different steps are as below:

Day - 4 We will clean the area thoroughly by spraying 4% formaldehyde solution

Day - 3 We spread the wheat straw on the clean platform, and sprinkle water over the straw with a pipeline. Frequently turn straw till it absorbs sufficient moisture. Wetting of the straw may continue up to 24-48 hours till it attains 70-75% moisture.

Day-1 When the straw is fully wetted, collect it as a low heap. Mix other composting ingredients viz., chicken manure, wheat bran and other fertilizers except gypsum and insecticides, and sprinkle water. Keep both wetted straw and these ingredients as such for 24 hours.

Day-0 We mix the two lots of the ingredients (straw + other additives). The mixed ingredients are then made into a high aerobic pile that is 5-6 feet wide and 5 feet high.

Day 1- 3 We keep the pile as such for 2 days. Temperature of heap starts rising and may go up to 70°C in 24-48 hours. Higher temperature is due to biological activity of microorganisms

Day-4 (1st turning) We turn the compost pile. Turning means mixing the material in a manner so that what is inside comes on the

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outside. This makes the mixture of ingredients homogeneous and aerobic. During reconstruction of the pile water is added whenever required. During the 1st turning itself the compounding mixture turns from golden yellow to dark yellow/light brown in color and there is a slight shrinkage in its volume, production of some ammonia and sometimes foul smell if pile is two wide or high or compact.

Day -7 (2^{nd} turning) We break open the pile and again turn it inside out. There will be further shrinkage of the pile. It will exhibit higher temperature. Color of the ingredients will further darken. Ammonia production will be higher. White flacks/powdery mass, which are known as fire fangs (Actinomycetes), will also be visible in the outer periphery of the compost (indicator of good compost).

Day-10 (3^{rd} turning) Again the pile is turned and the required quantity of gypsum 35 Kg is added.

Day-13 (4^{th} turning) The compost is turned and stack is made

Day-16 (5^{th} turning) The compost is turned and stack is made

Day - 19(6^{th} turning) The compost is turned and stack is made

Day-22 (7^{th} turning) The compost is turned. The insecticide is added during this turning. One may spray Melathion or Decis @ 0.01% for killing insects and pests.

Day-26 (filling day) We break open the pile, check for the smell of ammonia. If no ammonia smell is there in the compost and instead a sweet smell is felt, the compost is ready for spawning. If ammonia smell persists then additional turnings are required to be given after every 2-3 days. If no ammonia, compost is ready for spawning. Spread it to cool it before spawning.

Farmers Innovations

In the beginning of 1980s farmers in Haryana region of India started preparing compost by long method. Diseases were bound to get established when we use this method of composting and don't give adequate emphasis on hygiene. Farmers found an alternative to the problem and they won't make compost or grow Mushroom at one location for more than two or three years. Farmers use formulae with bran or cakes and fertilizers as N source instead of chicken manure which is

the main source of yellow mould and other diseases. However, this may not be a long term solution and best way may be to shift to short method of compositing.

Another innovation is in the method of turning where farmers make large number of piles in parallel and to turn, take one half of the two adjacent piles to create a new pile. Half left at the end in last pile is turned over itself as a result of which we may see a shorter pile at one end (Fig. 3.1). This ensures that the inside of the pile comes to the outside after each turning and there is adequate aeration. Farmers have also standardized the height and it is only kept 4-5 feet as the outside climate when compost is made is relatively hot and aeration may be less if pile height or width is more. In the beginning of the season farmers use wheat straw but later on shift to paddy straw as the same is much cheaper costing less than half of the cost of wheat straw.

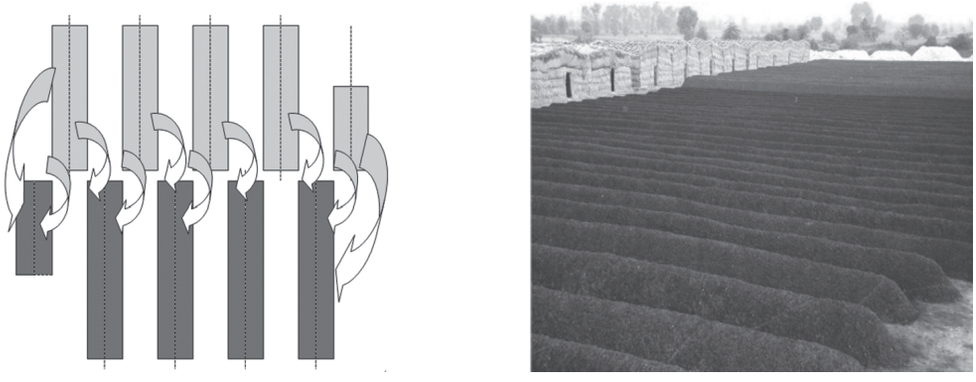

Fig. 3.1: Compost piles and method of tuning

Zero-Energy Poly Tunnel (ZEPT)

This technology was developed at Directorate of Mushroom Research, Solan and is being successfully used for compost preparation for cultivation of white button mushroom by many resource poor farmers in Bihar. It is a novel composting technology for small-scale seasonal button-mushroom growers. The technique involves inserting pipes with holes in the compost pile as shown in Fig 3.2. However, these innovations are only to make reasonably good compost till the farmer shifts to short method of compositing. In the long run the long method of compositing has to be discarded.

Fig. 3.2: Zero energy poly tunnel

Notes

What is Good Compost?

It is very important to identify good compost as this the basis for good mushroom production. A good compost should be dark brown in colour, should not be greasy or sticky, should have distinct sweet inoffensive smell, free from ammonia smell, should have about 65-67% moisture and pH 7.2-7.8. There should not be visible growth of other undesirable organisms except for the fire fangs (Actinomycetes) and it should be free from insects and nematodes.

INTEXT QUESTIONS 3.2

Select the correct option

(i) Time taken for making compost by long method is

(a) 10 days

(b) 16 days

(c) 22 days

(d) 28 days

(ii) The compost made by long method

(a) Takes more time of compositing than short method compost

(b) Gives poor yield than short method compost

(c) Has more incidence of insects and diseases due to pasteurisation

(d) All of the above

(iii) The compost is turned after every few days

(a) To uniformly mix all the ingredients

(b) To attain uniform moisture content

(c) To ensure good supply of oxygen in the pile

(d) All the above

(iv) We get 2.0 tons or less compost from one tonne of dry straw in long method of composting. (True/False)

(v) Compost is produced under outdoor conditions and gets invaded by many pests/competitors/diseases and hence not of good quality. (True/False)

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3.3 SHORT METHOD OF COMPOSITING

This is the preferred method of compositing now-a-days. To get more production in fewer days, short method of compositing is used. In this case, ingredients are mixed, wetted and a pile is prepared and turned 2-4 times (Phase-I) just as in case of long method. During this process gypsum is also added. These days instead of making pile, the pre-wetted ingredients are filled in specially designed structures called bunkers. These have perforated pipes in which pressured air is introduced regularly/ at regular intervals so that the conditions inside the composting material remain aerobic. After this, compost is filled in specifically designed structures called tunnel for Phase-II of composting.

We have seen that short method consists of two phases.

Phase-I: It is outdoor composting and lasts for 10-12 days.

Phase-II: It lasts for around seven days and involves pasteurization and conditioning of the compost inside an insulated room called tunnel).

Before we start making compost it is important to choose the correct formulations. It will vary from place to place depending upon the availability of ingredients. For example, in northern India we prefer wheat straw, in Southern India, people use rice straw, in states like Maharashtra some growers use sugarcane bagasse, mustard straw, soybean straw also. Mostly a formulation based on wheat straw and chicken manure is widely used in the country. (Wheat straw 1000 kg, chicken manure 500 -700 kg, urea 15-20 kg, wheat bran 50-75 kg, gypsum 50 -70 kg). Let us try to understand that how we make compost by short method.

3.3.1 Phase-I or Outdoor Composting

Before starting the composting, we wet the ingredients. Wheat straw and chicken manure are wetted thoroughly till they absorb sufficient water (around 75%). Leached water is collected in a goody pit constructed for the purpose and is regularly reused for wetting the materials. After thorough wetting of the substrates a simple heap/stack is made out of such materials. We break open the stack after 2 days, add water to the dry portions and again make a stack. Thereafter we start the preparation of compost.

Just like you studied in the long method of compositing, on zero day we break open the stack and then add the entire quantities of other raw materials like urea and wheat bran. Water is also added if required and a high aerobic stack is made (Fig. 3.3). Dimensions of the stack are about 5' × 5'.

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We turn the compost again after every 2 days and add gypsum at third turning. Gypsum can be added at earlier stages. In all, we give three to four turnings. On 8th – 12th day the compost is ready for filling in the tunnels for pasteurization this is the end of Phase-I.

Fig. 3.3: Compost pile during Phase-I

We can also do Phase I in bunkers (Figure 3.4) which are open un-insulated enclosures where there are pipes in the floor at distance of 30-40 cm with small (6 mm diameter) holes at 30 to 40 cm distance. After pre-wetting for two days and thorough mixing of all the ingredients, we shift the material to bunkers where temperature of 75-80°C is achieved inside the compost. Air can be injected regularly or in pulses and material is shifted to next bunker after mixing after 2-3 days. We make about three to four such changes/turnings before the composting material is shifted to tunnels for Phase-II.

Fig. 3.4: Compost filled in bunkers during Phase-I

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At the end of phase I we can see that compost is brownish throughout. Moisture at this stage is around 72-75% moisture. We can test it by squeezing part of compost in our hand. When squeezed drops of water appear between the fingers. At this stage compost has strong smell of ammonia.

3.3.2 Phase II of Compositing

We perform this phase in a pasteurization tunnel. A tunnel is an insulated room with perforated floor through which air can be introduced/ re-circulated (Fig. 3.5). Recirculation duct has an opening for the introduction of fresh air. This opening normally has a 2 micron washable HDPE filter. The size and design of tunnel will vary depending upon the amount of compost to be prepared.

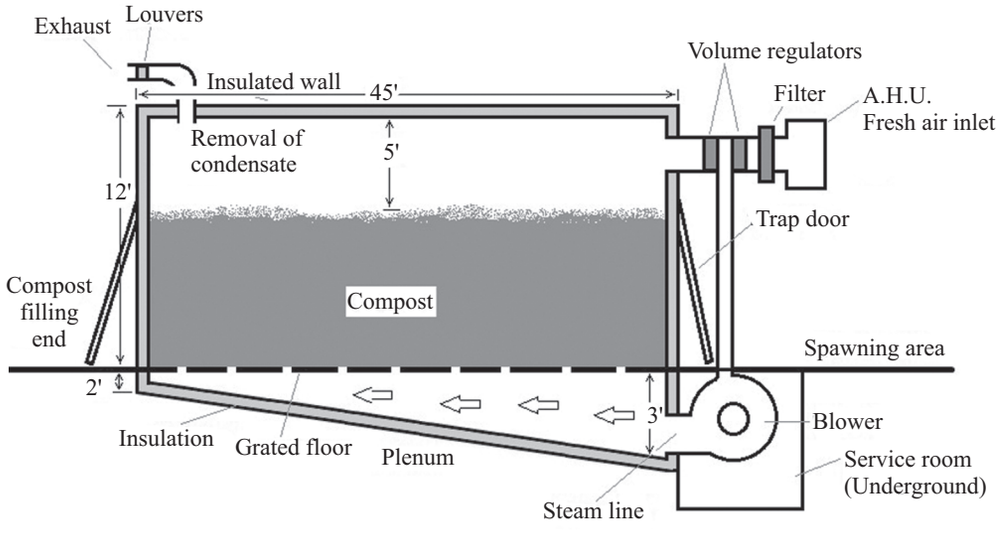

Fig. 3.5: Schematic view of tunnel

We can divide the Phase II process into three stages namely pre-pasteurisation conditioning (PPC), pasteurization (Kill) and post pasteurisation conditioning (POPC). At all stages we provide at least 10-20% fresh air and at no stage we stop the introduction of fresh air completely.

Pre-Pasteurization Conditioning (PPC)

After filling the compost in the tunnel, the temperature of the compost starts rising. Recirculation of air is started and 10-20% fresh air is given. During this phase of composting, whole of the compost mass is brought to a temperature range of 45-52°C which is optimum for the growth of thermophilic flora (Fig. 3.6). During this phase major part of NH_3 gets fixed in lignin-humus complex or as microbial biomass and excess of ammonia is released into the atmosphere.

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Fig. 3.6: Fire fangs in ready compost

Pasteurization

We start pasteurization after a day or so when temperature starts rising above 55°C. We can slightly reduce fresh air at this stage that helps in further increase in temperature. Main purpose of pasteurization is to kill or inactivate harmful organisms. Compost is pasteurized properly when temperature in middle of the pile is 59°C for 4-6 hours (Fig. 3.7). In active compost this temperature reaches automatically and in few cases use of live steam to heat up the compost may become essential. Temperature above 60°C is harmful as this temperature may kill all kinds of organisms necessary for the remaining part of Phase II.

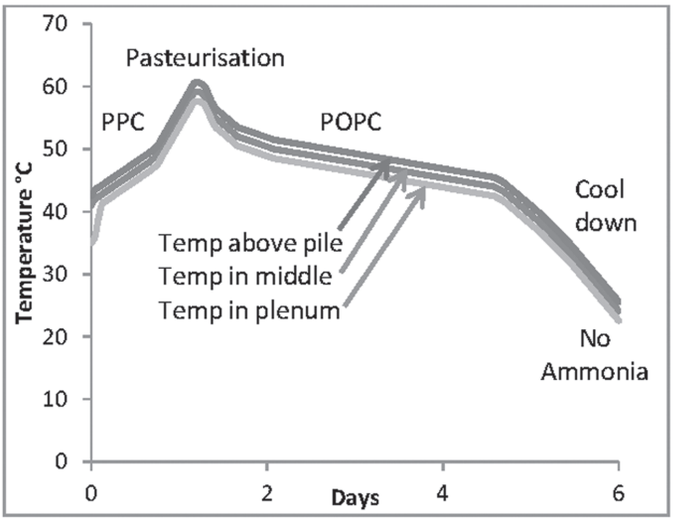

Fig. 3.7: Temperature profile above, in middle and below the pile in tunnel

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Post Pasteurisation Conditioning (POPC)

After pasteurisation we slowly lower the temperature to a range (45-52°C). At this temperature thermophillic organisms can grow easily (Fig. 3.7). POPC again regenerates the lost thermophilic organisms during pasteurization. Besides keeping compost at a particular range of temperatures (45-52°C), during this phase enough of oxygen is supplied to the compost mass to maintain fully aerobic conditions. In fact at no stage the fresh air should be completely closed as the compost is a living material. Both pasteurization and conditioning make the compost selective for the growth of white button mushroom.

We fill the compost uniformly in tunnel/ bulk chamber up to the height of 2-2.2 meters. Tunnel may have iron gratings, cemented floor with plenum (Fig 3.8) or may be made of pipes similar to bunker (Fig. 3.9). In our country most of the bunkers have pipes and most of the tunnels have plenum. One square meter of space normally occupies approximately 900-1000 kg of compost. We place the temperature sensors below (in plenum), in the middle and above the compost in the tunnel. Just after filling, we close the doors and switch on the blower for harmonising the temperature which after few hours will be around 45-48°C. Levelling off may take 4-5 hours and at this stage very little fresh air is generally introduced in the tunnel. After levelling we start the Pre Pasteurization Conditioning (PPC) and at this stage slight amount (10-20%) of fresh air is necessary. We keep the compost temperature between 45-52°C for one-two days. After this, the compost is now ready for pasteurization. Now we gradually reduce the fresh air. It will lead to gradual increase of the temperature of the compost by approximately 1°C/hour. Required temperature (58-59°C) of compost (that is on the sensor in the middle) needed for pasteurization may reach in 10-12 hour by self-generation of heat. The difference in the temperature above the compost (air temperature), inside the compost and plenum (below the compost) should be as less as possible and may not exceed 3-4°C. This process is called pasteurization. We do the pasteurization for 4-6 hours.

After pasteurization, we again increase the fresh air flow and temperature of the compost is brought down @ 1.5°C/hour and finally maintained between 45-48-52°C till there is no detectable smell of ammonia (less than 10 ppm) in the compost. This phase is known as post pasteurization conditioning (POPC) of the compost, which is normally accomplished in 3-4 days. After conditioning we bring down the temperature of the compost to 25-30°C by introduction of fresh air in the tunnel. When this temperature reaches, the compost is ready for spawning.

In phase–I there is about 30% loss in weight and in phase–II, about 25 % loss in weight takes place. As a result from the standard formula of one tonne wheat straw, we can get about 2.5 tons of final compost.

Fig. 3.8: Tunnel with iron grating

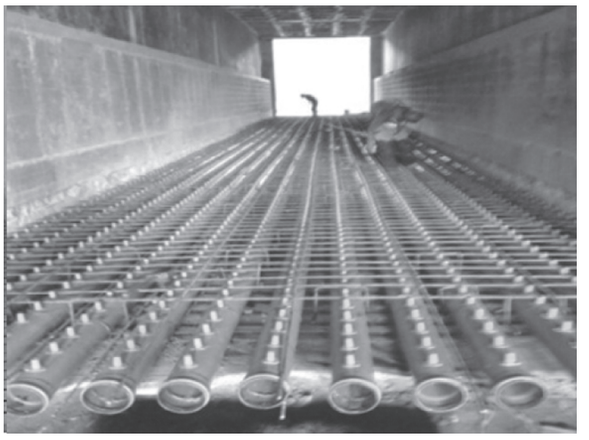

Fig. 3.9: Tunnel with pipes and spigots (under construction)

Characteristics of the Compost after Phase-II

- Dark brown in colour, full of thermophilic fungi and actinomycetes.
- It is soft, straw breaks rather easily.
- Moisture around 64-66%. No liquid oozes when squeezed firmly
- Pleasant sweet smell
- No stickiness. Hands stay clean and dry
- N content > 2%
- Ammonia below 10 ppm

Notes

Difference between long method and short method of Compositing

Parameter	Long method	Short Method
Time taken	Preparation of compost takes 28-30 days.	Preparation of compost takes 16-17 days.
Quantity produced	We get 2.0 tons or less compost from one tone of dry straw.	We get >2.5 tons compost from one tone of dry straw.
Phases	It is single phase method and compost is produced under outdoor conditions.	It is two phase method. Phase I is done outdoors and phase II is done under controlled conditions.
Diseases and nematodes	Compost gets invaded by many pests/competitors/diseases and hence not of good quality. Frequent sprays of insecticides and fungicides are required to check these diseases and insects/ nematodes.	In phase II compost is pasteurized by heat to get rid of diseases and insects. As a result the compost is free from unwanted chemicals and disease causing organisms.
Effect on environment	Most of the ammonia is lost in the atmosphere resulting in low final N content of compost. We get low yields and the technology is not environment friendly.	Short method is more environment friendly as during phase II ammonia is recirculated under controlled conditions and is converted to biological protein
Yielding ability	Mushroom yields are less and erratic as compared to that from short method of compost.	The compost quality is better and gives consistent and higher yields as compared to long method compost

INTEXT QUESTIONS 3.3

Answer the following questions

(i) What is the temperature for pasteurisation of compost?

(a) 40-43°C (b) 45-52°C (c) 57-60°C (d) 62-63°C

(ii) Suitable temperature for conditioning of the compost is

(a) 40-43°C (b) 45-52°C (c) 57-60°C (d) 62-63°C

(iii) Short method is better than long method (Yes/No)

(iv) Fresh air can be completely stopped during pasteurization (Yes/No)

(v) Ammonia in the final compost should be below 10 ppm (Yes/No)

Notes

3.4 PROCEDURE FOR CULTIVATION OF BUTTON MUSHROOM

The major steps involved are mixing spawn in the compost, allowing the mycelium to spread in the compost, then put a layer of soil (casing) over it. After mycelium penetrates into the casing soil, temperature is lowered down and fresh air is given for formation of mushrooms. The details of these steps are as below:

3.4.1 Spawning, Spawn run and Casing

Soon after cooling the compost in tunnel, mix the spawn with the compost @ 0.5-1% and fill the spawned compost in bags. Farmers cultivating mushrooms in huts spread the compost on beds up to depth of 4 to 6" and do the spawning on beds itself. Bags can be filled up to a feet. Normally 10-12 kg compost is filled per bag (Fig. 3.10 and 11).

Fig. 3.10: Cultivation of button Mushroom in bags

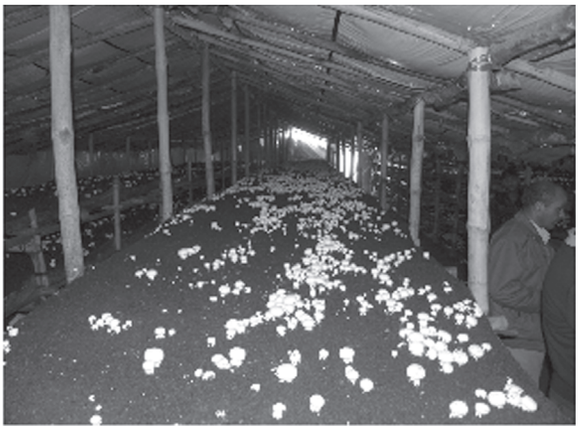

Fig. 3.11: Cultivation of button Mushroom in shelves

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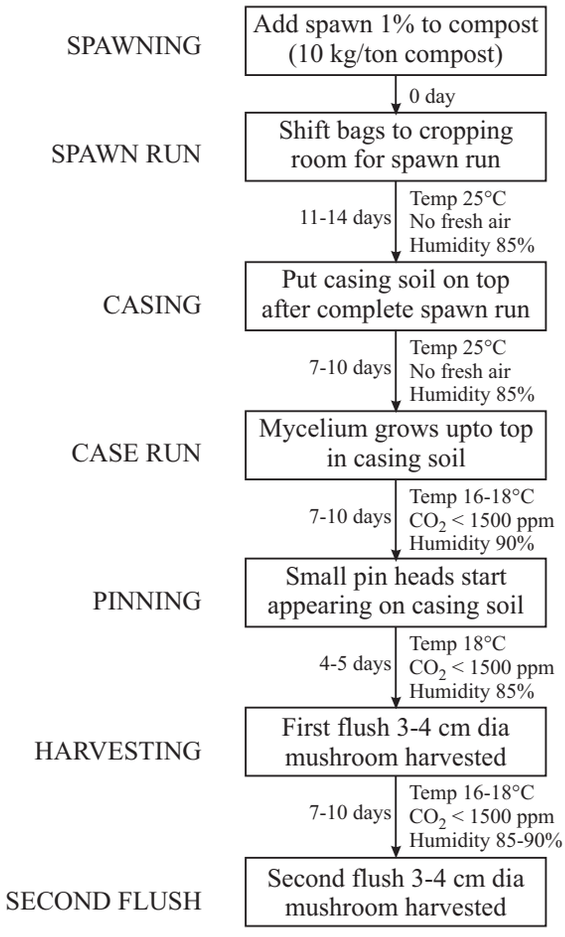
We keep the bags at a temperature of 23-24°C. Under this situation, the temperature inside the bags is around 25°C. When spawn starts spreading inside the compost, there is rise in temperature inside the compost. During spawn run stage the rooms are mostly kept closed (carbon dioxide content can go up to 10,000 ppm and can be suffocating). In 12-15 days spawn spreads into whole of the compost. At this stage, the bags are cased. Casing means covering the top of bags with a special soil commonly called casing soil. We add about 1.5 inch thick layer of casing soil. Casing soil can be mixture of coir pith, farm yard manure, burnt rice husk and soil.

3.4.2 Cropping

We do watering just after casing to keep it wet. Temperature is kept around 25°C for a week or so. During this period mycelium travels into casing soil. After this stage, we gradually lower the temperature to 16-18°C and introduce fresh air to lower the carbon-dioxide concentration to 1000-1500 parts per million (ppm). This induces pinning (small pin head size fruit bodies), which mature into fruit



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bodies within 3-4 days. The mushrooms are harvested. Similar conditions of temperature (16-18°C), humidity (85-95%) and carbon-dioxide (1000-1500 ppm) are maintained to get next flush (crop) of mushrooms. In general 3-5 flushes can be obtained in 4-6 weeks' time. Commercial units normally do not take more than two to three flushes.

During growth of mycelium and fruit-bodies lot of carbon dioxide is produced. Normal carbon dioxide in air is less than 400 ppm (0.04%). But during spread of mycelium it can go up to 1% or even more. As mentioned earlier, for induction of fruit bodies we lower the level to 0.1% or so. Normal composition of air is as given Table 3.1. You can see that in normal air the carbon dioxide is around 400 ppm or 0.4%.

Table 3.1: Normal composition of air

Gas	% by volume	ppm by volume
Nitrogen	78.08	780805
Oxygen	20.94	209450
Carbon dioxide	0.04	380
others	0.94	9365
Total	100.00	1000000

3.4.3 Harvesting and Post-harvest Storage

One of the major problems of mushrooms is their short shelf life. Hence soon after harvesting we should keep these at low temperatures (6-8°C) and also transport in refrigerated vans. Packaging can be done in punnets (small boxes) instead of poly-bags. The mushrooms can be canned, freeze dried, or used for making pickles and number of other products.

3.4.4 Economics and Profitability Measures

Cultivation under natural conditions during winter seasons requires little facilities as compared to cultivation under controlled conditions throughout the year. The cost of cultivation thus, is more under controlled than that under natural conditions. In general the cost of production of white button mushroom under natural conditions is Rs 50-55/kg whereas under controlled conditions, it may be around Rs 60/kg. The selling price varies from Rs 70-100 depending on season and demand. We can enhance profits through value addition. Thus, growing mushroom is a highly profitable venture. It is, however, very important to maintain hygiene and strictly follow the cultivation protocol.

Notes

INTEXT QUESTIONS 3.4

Answer the following questions

(i) What should be the temperature during pin head formation of button mushroom?

(ii) What should be the carbon dioxide concentration during pin head formation of button mushroom?

(iii) What should be temperature of bags during spawn run?

(iv) How much spawn should be added to 100 kg compost?

(v) What is the normal amount of carbon dioxide in air (in ppm)?

3.5 ABOUT MUSHROOM FLUSHES

As we have seen that we can keep on getting mushrooms after harvesting one crop from a substrate. These are referred as flushes. How many flushes we should take? In other words up to what time it is economical to keep on taking flushes. In button mushroom it varies on method of cultivation. Seasonal growers in North India in plains, who grow only one crop of this mushroom in winter, keep on taking flushes till mushrooms are appearing. It may be mentioned here that most of the yield can be obtained in first 3-4 flushes and with every flush there is decrease in yield. With passage of time the compost starts getting exhausted and thus both quantity and quality of mushrooms keeps on decreasing.

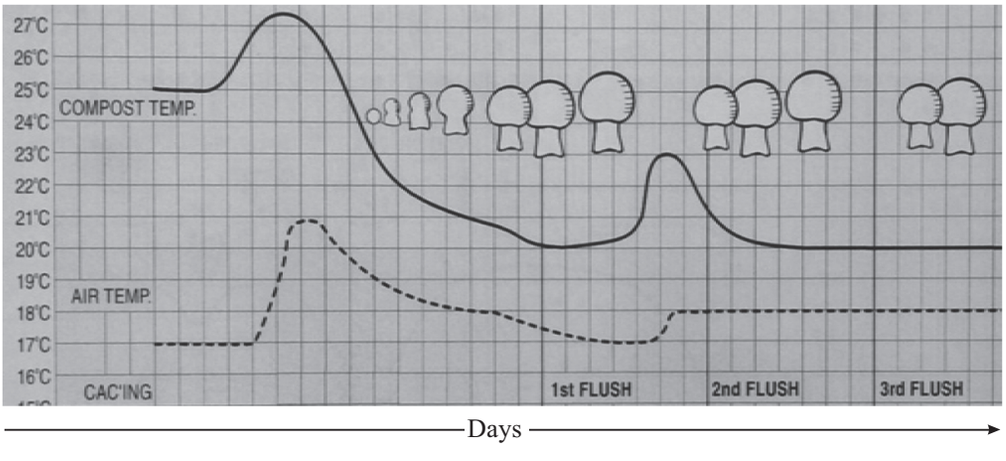


Fig. 3.12: Temperature of compost and cropping room after casing

Commercial units, however, take two or three flushes. Few years ago most of the farms were taking three flushes as 50% of yield is obtained in first flush, 35% in second and 15% in third flush (Fig 3.12). Now most of the farms have shifted to two flushes for the reason that it is not relatively low yield or quality in third flush, but also increased chances of diseases. One may be able to earn more by taking two flushes per crop instead of three flushes. One of the reasons for this is that labour is getting costly and secondly despite all precautions some diseases may appear and it is better to discard the substrate after two flushes.

The significance of 3 H, Hygiene, Humidity and Homogeneity must be understood for better mushroom cultivation. Spawning and bag filling is to be done under hygienic conditions and whether spawning and bag filling will be done by hands or machines will depend upon the volume of compost to be handled per day.

Given below is a chart showing the temperature of air and compost after spawn run and casing up to third flush (Fig 3.12). Note that compost temperature is more than the air temperature at all stages.

INTEXT QUESTIONS 3.5

State True or False

(i) Seasonal growers take 2-3 flushes.

(ii) Commercial growers take 2-3 flushes.

(iii) Temperature of the compost is higher than that of the air.

(iv) It is more economical for commercial growers to take only 2 flushes than 3-4 flushes.

(v) Fifty percent of the yield is obtained in first flush at commercial units.

3.6 HOW TO HARVEST AND PACK MUSHROOMS?

Mushroom harvesting is an art. We need to pick each mushroom by gently rotating, hold it lightly in your fingers and cut the stipe in a manner that cut part falls into the bin meant for it and the mushroom is put in punnet or bag. Trained workers can harvest 2-3 mushrooms simultaneously, hold in different fingers and cut their stipes.

It has been observed that in many parts mushrooms are just picked in bulk, pooled and then cut. This results in spoiling of mushrooms and there is no alternative

Notes

except to wash such mushrooms. This involves washing in water using Potassium meta-bisulphite (KMS), a commonly used preservative in food industry. Its improper dose leads to yellowing of mushrooms and in any case the shelf life of washed mushroom is less than unwashed mushroom. Hence, it is better to harvest in standard manner and avoid washing. All over the world and also in many parts of India, particularly Maharashtra and South India the mushrooms are sold unwashed.

Packing is done in punnets or poly-bags. It is important that there should be holes for aeration otherwise the mushrooms will get spoiled very soon. Wherever possible, the mushrooms should be kept in cool place (4-8°C) just after harvest. Watering of bags should be done after harvesting of mushrooms as wet mushrooms have shorter shelf life.

INTEXT QUESTIONS 3.6

State True or False

(i) Mushrooms should be picked by gently rotating it while holding it lightly in fingers.

(ii) Trained workers can harvest 2-3 mushrooms simultaneously, hold in different fingers and cut their stipes.

(iii) It is better to wash mushrooms after harvest.

(iv) Bags should be watered before harvesting the mushrooms.

(v) After harvest mushrooms should be kept in cool place.

WHAT YOU HAVE LEARNT

Let us recapitulate the important points you have learnt in this lesson:

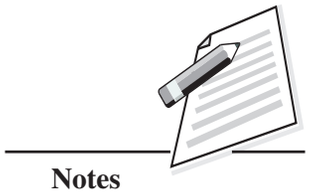
- Button mushroom is most popular in our country and accounts for 3/4th of the total mushroom production of the country.
- Major ingredients of compost are straws, chicken manure, bran, fertilizers and gypsum. The nitrogen content of the starting mixture should be between 1.5 to 1.75%. It is important to ferment the compost to make it selective for the growth of button mushroom.
- Compost can be prepared either by long or short method. Long method is a single phase method that takes about 28 days and is a primitive and less preferred method.

- Short method is a two phase system where part of the compositing is done outside called Phase-I and remaining part is done closed structures called tunnels (Phase-II).
- During pasteurization the temperature should not exceed 60°C.
- Composting is aerobic fermentation and to provide oxygen at all stages the compost is turned regularly or fresh air is introduced in the compost from below.
- The ready compost should have no smell of ammonia and have pH 7.2-7.8.
- After spawning the compost is kept in rooms at 25°C; spawn run takes upto 2 week after which casing is done and temperature is still kept at 25°C for 10 days or so till mycelium penetrates casing soil.
- To induce fruiting the temperature in the cropping room is lowered to 16-18°C and carbon dioxide content is lowered to 1000 to 1500 ppm by introducing fresh air at regular intervals.
- Mushrooms appear in flushes. Seasonal growers take 5-7 flushes or till the mushrooms keep on appearing. Commercial units take 2-3 flushes.
- After harvest mushrooms are preferably kept at low temperature (4-8°C) and packed in punnets.

TERMINAL EXERCISE

1. What are the ingredients of compost and how Nitrogen is calculated in the starting mixture of ingredients?
2. Why we turn the compost at regular intervals. How many turnings are normally given in long method of compositing?
3. Is short method better than long method of composting? Explain.
4. What are the drawbacks of long method of compositing?
5. Describe the procedure related to temperature and aeration to be followed after filling the compost in tunnel.
6. Describe the requirement of temperature and carbon dioxide from spawning till formation of mushroom.
7. How will you manage a button mushroom farm?

ANSWERS TO INTEXT QUESTIONS



Notes

3.1

(i) True (ii) False (iii) True (iv) True (v) True

3.2

(i) (d) (ii) (d) (iii) (d) (iv) True (v) True

3.3

(i) (c) (ii) (b) (iii) Yes (iv) No (v) Yes

3.4

(i) 16-18°C (ii) <1500 ppm (iii) 25°C (iv) 0.5 kg

(v) 380

3.5

(i) False (ii) True (iii) True (iv) True (v) True

3.6

(i) True (ii) True (iii) False (iv) False (v) True

SUGGESTED ACTIVITY

- Procure button mushroom from the market. Cut it vertically to see different parts of the fruit body. Draw the diagram of vertical section and label it as Pileus (Cap), Stipe (Stem), and Gills (the brown layer on sides of the cap). Try to collect open mushrooms to see the gills clearly.
- Procure button mushroom form the market. Try to grade them on the basis of their size and quality (closed, about to open, or open)

Key Learning Outcomes

- Grow button mushroom crop as per recommended method.
- Pick, wash, grade and pack the harvested button mushroom.