



# 11

## MUSHROOM GROWING UNIT/HOUSE

Proper site selection, correct design and standard construction is important to get maximum produce and benefit. Many a times we make mistakes at the initial stages which cannot be easily rectified at later stages. Setting up mushroom unit at wrong location or constructing wrong type of bunker, tunnel, cropping room, etc can mean inadequate yields. In mushrooms as we have seen that it is a chain and mistake at any stage affects the whole system. You might have heard about law of limiting factors. For example if there is a narrow road, then the speed of the traffic will be determined by the slowest moving vehicle. Hence, greater attention is needed at initial stages of setting up any industry and same is true for mushroom production units.



### OBJECTIVES

After reading this lesson you will be able to

- select appropriate site from point of market, infrastructure, availability of labour, water, electricity, etc;
- assemble facilities required near the unit;
- design unit for seasonal cultivation of button mushroom;
- follow the different steps in construction of huts;
- design facilities for phase-i compositing for button mushroom including development of bunkers;
- design and develop tunnel for phase ii for button mushroom;

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- design cropping rooms for round the year cultivation of button mushroom;
- understand the need for synchronisation in size of cropping room with tunnel, that of tunnel with bunker and so on for complete unit of button mushroom.
- identify different types of structures for growing other mushrooms.



Notes

### 11.1 SITE SELECTION CRITERIA

Proper choice will mean greater operational efficiency and cost effective production of mushrooms at the farm. You may consider the following points while selecting the site.

1. It is apt that chosen site should preferably be away from the municipal limits, as while composting, there are various types of smells, which may not be harmful in anyway, but are still not accepted by inhabitants in the cities.
2. That the site is near to the market, linked by a motorable road, has availability of good quality water, easy and cheap availability of raw materials especially straw and poultry manure.
3. That adequate and cheap labour in abundance is available in the region.
4. Uninterrupted power supply is desirable as production of electricity by diesel is costly and not economical.
5. Reasonable nearness to hospital, school and small market adequate for the labour and their children will be useful to retain the labour on site and meet their daily needs.



#### INTEXT QUESTIONS 11.1

State True or False

- (i) Uninterrupted power supply is desirable as production of electricity by diesel is costly and not economical.
- (ii) Unit should preferably be outside the municipal limits.
- (iii) Easy availability of raw materials, quality water and labour are important considerations for selecting the site.
- (iv) Site for disposal of spent substrate is important as its accumulation near the site of cultivation can lead to more diseases.
- (v) It will be better if there is canning unit as part of the unit or near the unit.



## Notes

## 11.2 FARM DESIGN FOR CULTIVATION OF BUTTON MUSHROOM

We have learnt that button mushroom is cultivated as a seasonal activity in huts and also as a commercial activity throughout the year under controlled conditions. Farm design for the two modes of cultivation is different.

### 11.2.1 Farm Design for Seasonal Cultivation in Huts

Most of the farmers in Haryana, Punjab, Uttar Pradesh and Utrakhand use huts of the size of about 28-30 feet  $\times$  60 feet or so (Fig. 11.1). It accommodates about 10-12 ton compost. For making the hut we clean the area and do the marking as per design (Fig. 11.1). This is followed by digging holes at the marked points for inserting bamboos. Thereafter we make racks using plastic rope, cover the hut with paddy straw that had polythene inside in the roof part to avoid damage due to rainfall and also sheets outside the sides of hut to control aeration and temperature. The polythene sheet is also spread on the racks and cultivation is done in beds instead of bags (Fig. 11.2). Material required for construction of hut is as given in Table 11.1.

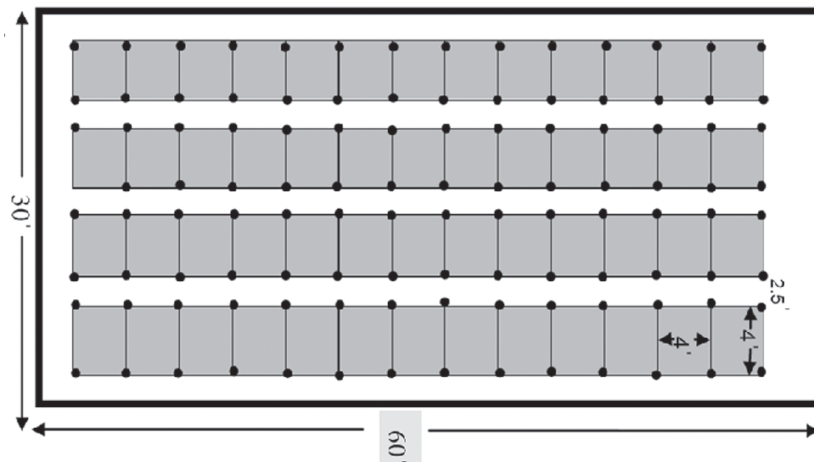


Fig. 11.1: Layout of hut for seasonal cultivation of mushroom





Fig. 11.2: Lay out and different steps in the construction of hut

Table 11.1: The cost of hut, raw materials required for making hut, compost, casing, labour, etc

Item	Size	Amount
Bamboo	12' long, 3" dia	100
Bamboo	10' long, 2.5" dia	220
Bamboo	20' long, 1" dia	280
Paddy straw		2 trolley
Plastic rope		10 kg
Polythene		35 kg

### 11.2.2 Farm Design for Environmentally Controlled Unit

Before we start thinking of establishing a commercial environment control unit, it is important to ensure:

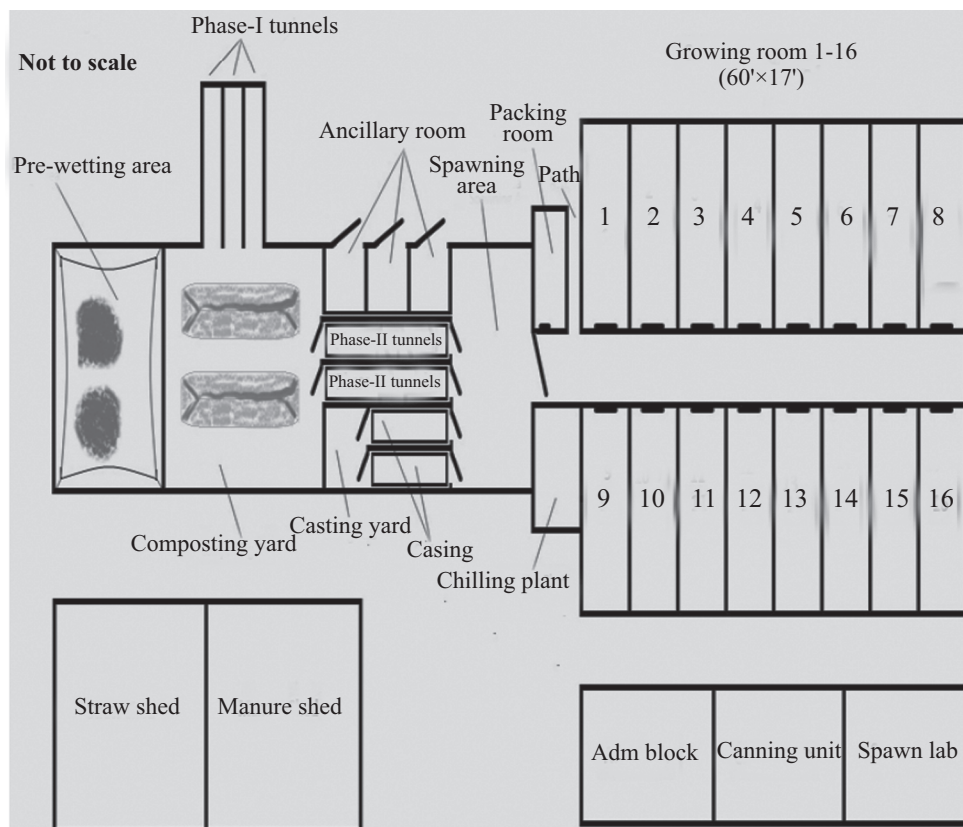
- To get good training, visit a commercial unit, study the market and obtain hands on experience in cultivation of mushroom.
- To develop project report with the help of experts for following better protocols and also getting loans.
- To arrange money in advance and take advantage of subsidies and other support provided by the government.

Commercial unit may consist of spawn production unit, compost production unit, cropping unit and canning unit. We have already learnt about the spawn production. Only big farms go for setting up their spawn lab and normally prefer to purchase the seed. In Europe, all the growers procure readymade compost. In India, however, the commercial units doing cropping make their own compost. Very few units go for setting up a canning unit. A layout of the unit with composting and cropping facilities at same location is given in Fig. 11.3.



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## Mushroom Growing Unit/House



**Fig. 11.3: Layout of complete mushroom unit having compost facility and cropping rooms**

We will discuss the design of composting area and cropping rooms separately. Layout of the composting area of a commercial unit is as shown in Fig. 11.4. In the initial days phase I was done only by making piles, these days however most of the growers are using bunkers.

Compost production unit will have under mentioned main components:

- **Pre wetting area:** For dumping of raw materials and their pre wetting (uncovered).
- **Composting yard:** For making piles out of the wetted materials (covered).
- **Phase-I bunker:** For phase-I composting (in case indoor composting is employed).
- **Phase-II tunnels:** For performing pasteurization and conditioning of the compost.
- **Casing soil chambers:** For pasteurization of the casing soil.
- **Spawning area:** For spawning of the prepared compost.



Pre wetting area 30' x 40'	40' x 60' Compost Yard	12' x 50' Bunker 1	Boiler room
		12' x 50' Bunker 2	Casing area/ casing tunnel 28' x 20'
		12' x 50' Bunker 3	Spawning area 32' x 20'
10' x 40' Tunnel 1			
10' x 40' Tunnel 2			
Store 30' x 20'			

Fig. 11.4: Design of compost facility

The size of different components will vary with the proposed capacity of the unit. It is important to synchronize various components. That is, after deciding the size of the cropping room (described later) we calculate the amount of compost that will be accommodated in this room. Accordingly, we decide the size of the tunnel so that compost required for that room can be produced in one tunnel. The size of bunker is determined by the size of tunnel and it is normally 1.25 to 1.5 times more in surface area than that of tunnel. Similarly the size of yard, pre-wetting area will depend upon the amount of raw materials to be handled at any given point of time.

In the cropping rooms we need to maintain a ratio of area for compost and air. We cannot overstuff the room. Actual calculations are bit complex but for rough estimate we use the following formula to calculate the amount of compost that can be put in a room:

$$\text{Approx. Room capacity (compost in Tonnes)} = (L' \times B' \times H')/600 \pm 10\%$$

Say we have a room 20 feet wide, 60 feet long and 12.5 feet high. It can accommodate compost =  $20' \times 60' \times 12.5'/600 = 25 \pm 10\%$ . That is, room can normally accommodate 25 ton compost and it may vary from 22.5 to 27.5 ton.

For calculating the amount of compost that can be produced in a tunnel we use the following simplified formula:

$$\text{Compost output of a tunnel (in tons)} = (L' \times B')/16 \pm 10\%$$

Say we have a tunnel 10 feet wide and 40 feet long from inside. It can be used to produce about 25 ton compost ( $10 \times 40/16 = 25$ ).

Please remember that these are simplifications and not actual values.





## Notes

**Bunkers for Phase-I:** These days most of the growers do phase-I in bunkers which are open structures having provision for aeration from below. This saves space and effort and you can process more compost in less area. Bunker has a network of pipes fitted with 4 to 6 inch long plastic pipes (spigots) having small (about 6 mm dia) holes at a distance of 40 x 40 cm (Fig. 11.5). Bunkers are filled up to 8-9 feet. The air speed of the fan in terms of CMH can be calculated on the basis of requirement of fresh air @ 50 CMH per ton of the final compost. We need high pressure fans to pass the air through the compost. The pressure of the fan can be in the range of 40-70 cmWG. You must understand that air speed and pressure are two different things and fan able to provide different air speed and pressure can be designed by the experts.

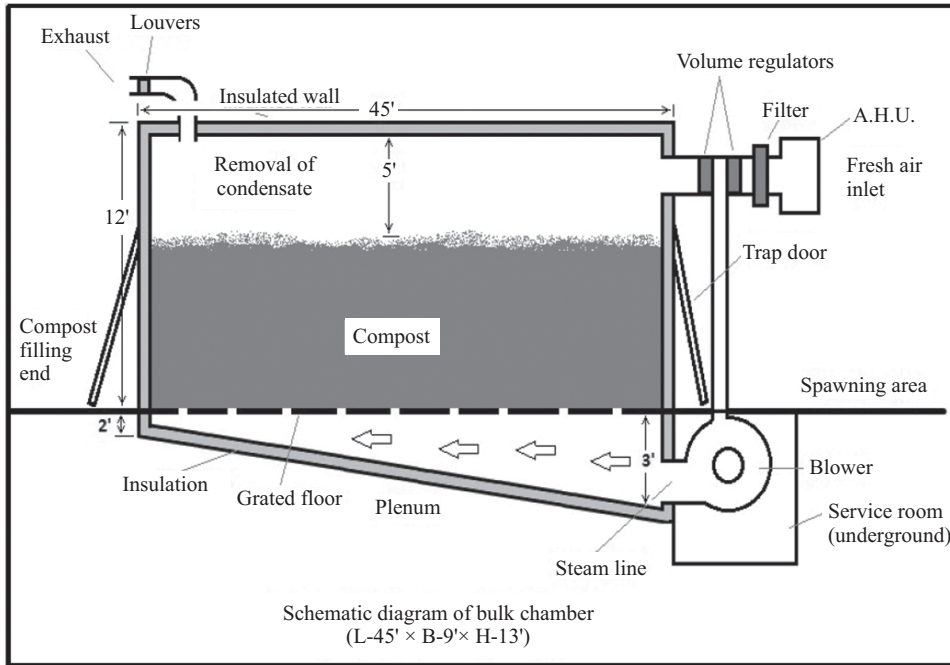


**Fig.11.5: Diagram showing pipes and spigot in a bunker under construction**

**Phase II pasteurisation tunnels:** Tunnel looks like any other ordinary long room with the difference that you can see a floor having holes. In this chamber the compost is handled in bulk, hence at times it also called bulk chamber. Actually this room is an insulated chamber with air tight insulated doors and it has space below it which is called plenum (Fig. 11.6). We push the air from below using a fan designed for this purpose and recirculate the air. The position of blower fan can be below the ground or above the tunnel on roof depending upon the design. There is also provision for injecting filtered fresh air and steam in the air being circulated. The tunnel has two exhaust vents, one for recirculation of air and the other for exhaust of gases on introduction of fresh air via dampers. Normally recirculation duct is made of aluminium and is outside the tunnel. In some tunnels you may see that the air circulation duct can be made of canvas and it can be inside the tunnel instead of outside as can be seen in Fig 11.7 (right). In the tunnel the compost is



processed at controlled temperature for pasteurisation and conditioning as described in earlier chapter on making compost by short method. One end of the tunnel normally opens towards the compost platform and the other end opens towards the clean spawning area (Fig. 11.7 left).



**Fig. 11.6: Side cross section of tunnel with plenum**



Complete view of tunnel with holes in floor    Compost with fire fangs ready for spawning.  
(Please note that the recirculation duct is of canvas and inside the tunnel)

**Fig. 11.7: Tunnel with holes (on left) and a canvas duct (on right)**

Complete view of tunnel with holes in floor    Compost with fire fangs ready for spawning. (Please note that the recirculation duct is of canvas and inside the tunnel)





## Notes

In the tunnel we fill the compost after completing the process of phase-I in bunkers. The compost in tunnel is filled up to 6 or 6.5 feet that means about one ton compost per square meter. There is about 25% loss in weight of compost in 5-6 days in the tunnel. The fan used in tunnel is of centrifugal type with its blades either radial or inclined/curved backwards. We calculate the quantity of cubic meter air to be blown per hour (CMH) by the fan by multiplying the area of tunnel in square meter with 200. For example in a tunnel with area of 20 sq m, we may need a fan of the capacity of 4000 CMH. The static pressure of fan should be 10-12 cm WG.

**Casing Unit:** There is need for another small insulated chamber similar to tunnel for pasteurization of the casing soil. There is no self heat generation by casing soil and hence we will have to install a boiler to provide steam for pasteurization of the casing soil. Sterilisation of casing soil can be done with Formalin, but it is better to pasteurize the casing soil. This chamber should be away from cropping rooms and well protected from dust.

### 11.2.3 Machinery required for Compost Making

Labour is a costly input and thus mechanisation is must at commercial unit. A JCB or tractor mounted with front end loader is required to handle the straw, wet it, turn it, and fill it. Conveyer belt and bunker filler/ tunnel filler is required for proper and loose filling of the compost (Fig. 11.8). In case the size of the tunnel is big then it may not be possible to manually spawn the compost and we may require a spawning and bag filling machine.



JCB or front loading assembly is used to turn/fill compost



Conveyer with front moving head for tunnel filling

**Fig. 11.8: Machinery required for making compost**

### 11.2.4 Design of Cropping Room

A viable commercial unit has 6-8 rooms. At least six rooms are required to ensure efficient use of the tunnel and also setting the cropping cycle in a manner that mushroom production is there throughout the year. The rooms can be on one side

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Notes

or on both sides of the corridor. All rooms are insulated using thermocol or are made 60-80 mm thick PUF (Polyurethane Foam) panels. We need specific dimensions as far as width of room and height of room is concerned. Width of room will depend upon the number of rows of racks that are proposed to be put. Normally the width of rack is around 4.5 feet. The width of path in between racks is never less than 3 feet and preferably may be one meter (3.3'). Thus, if there are two rows, there will be three paths and thus width of room will be =  $3.3 + 4.5 + 3.3 + 4.5 + 3.3 = 19.2$  feet. These are inside dimensions and we can add about two feet for walls and insulation. Similarly height is determined by number of racks. There is space below the lower most rack and also above the top most rack. Distance between racks is 2'. For four racks a room of 10.5' height is required, for five racks 12.5'; for six racks, 14.5'. Two feet are added to height for every rack. Length is normally three times the width of the room. It can be somewhat more or less but air circulation becomes a problem if length is more than 100 feet. In rooms with two rows, there are two air ducts on the sides with holes on lower side. Fig. 11.9 shows cross section of such a cropping room. The size of the duct, size of hole and distance between holes will depend upon the dimensions of the room. These ducts are connected to Air Handling Unit (AHU) which has mechanism for cooling and also humidification. The amount of the air and cooling capacity of AHU is determined by the maximum amount of compost proposed to be filled in the room. For smaller units one can have independent AHUs and for larger unit it is economical to have central cooling facility.

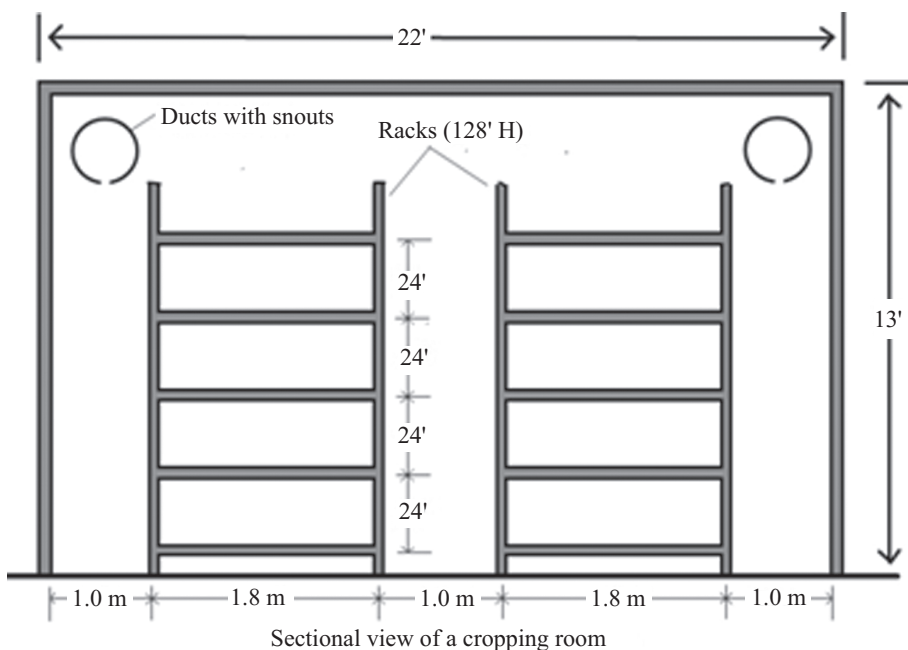


Fig.11.9: Design of cropping room with two rows (Front view)



## Notes

### 11.2.5 Farm Design of Other Mushrooms

Design of compost yard will depend upon the method of substrate treatment selected for cultivation. For oyster and milky mushroom you may construct tanks for chemical pasteurisation or may have arrangement for hot water treatment. The spawning area is supposed to be clean concrete floor.

Mushrooms other than button are cultivated in our country under natural conditions. The design of the huts varies as per the ingredients available. Oyster is mostly cultivated in simple rooms where the bags can be hanged in tiers or in sheds made from paddy straw or coconut leaves. Milky mushroom is mostly cultivated in sheds having blue sheet and the floor is normal about 2-3 feet below the ground level. Bags are kept at the floor only. Paddy straw mushroom is cultivated mostly in open under the shade of the trees in coastal areas of Odisha.



#### INTEXT QUESTIONS 11.2

Fill in the blanks

- (i) For seasonal cultivation of button mushroom the normal size of hut is ..... × ..... feet.
- (ii) Approximate cost of making hut is about Rs .....
- (iii) Approximate amount of compost that can be made in tunnel of size 12' × 48' is ..... ton.
- (iv) In cropping room with two rows of racks, each having five shelves, the width and height of the room will be ..... and ..... feet respectively.
- (v) The abbreviation AHU stands for .....



#### WHAT YOU HAVE LEARNT

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

- Site selection is first important step and it may be assured that the site is linked to markets, labour, raw materials, water, electricity is easily available.
- For seasonal cultivation, greater hygiene and treatment of bamboos from year to year is must to avoid transmission of diseases.
- Any mistake in the farm design has a long term effect. It is important is to choose proper design of the room, then workout the compost that room will



accommodate. Accordingly, decide the size of tunnel. It is better to have slightly oversized tunnel. Similarly the size of bunker will depend upon the size of tunnel which normally is 1.25 to 1.5 times more in terms of surface area. Number of tunnels will depend upon the number of cropping rooms and number of bunkers is one more than the number of tunnels. The size of the compost yard will be affected by the total number of bunkers and their size. It is important to understand that sizes of all structures are interlinked.

- The capacity and type of fan in bunker, tunnel and cropping room also requires proper calculation of speed and pressure required.
- In button mushroom there are commercial models available whereas for other tropical models the models are yet to be developed in India. In our country even large scale cultivation of these mushrooms is done as a seasonal activity only. Hence, cultivation is mostly in huts and the design and material used for construction of huts varies from place to place.



### TERMINAL EXERCISE

1. Why cost of cultivation in huts is more in the first year and less in subsequent 4-5 years?
2. What is relation between size of bunker, size of tunnel and cropping room?
3. Can the compost by short method be made without having bunkers?
4. What will be its width of a cropping room having four rows of stands?
5. What will be the height of a cropping room having seven tiers in each rack?
6. What happens if the recirculation duct of tunnel has more bends?



### ANSWERS TO INTEXT QUESTIONS

#### 11.1

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

#### 11.2

- (i) 28' × 60'      (ii) Rs 45000      (iii) 36 Ton  
(iv) 19' and 12.5'      (v) Air Handling Unit



Notes

### SUGGESTED ACTIVITY

Compile rates of wheat straw/ton, charges of labour/month, Charges of electricity for mushroom production, list of spawn suppliers around your area.

### Key Learning Outcomes

- Design and develop mushroom production growing structure/unit.