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SEM-2

Paper: Mycology and Phytopathology

Lesson: Mushroom Cultivation

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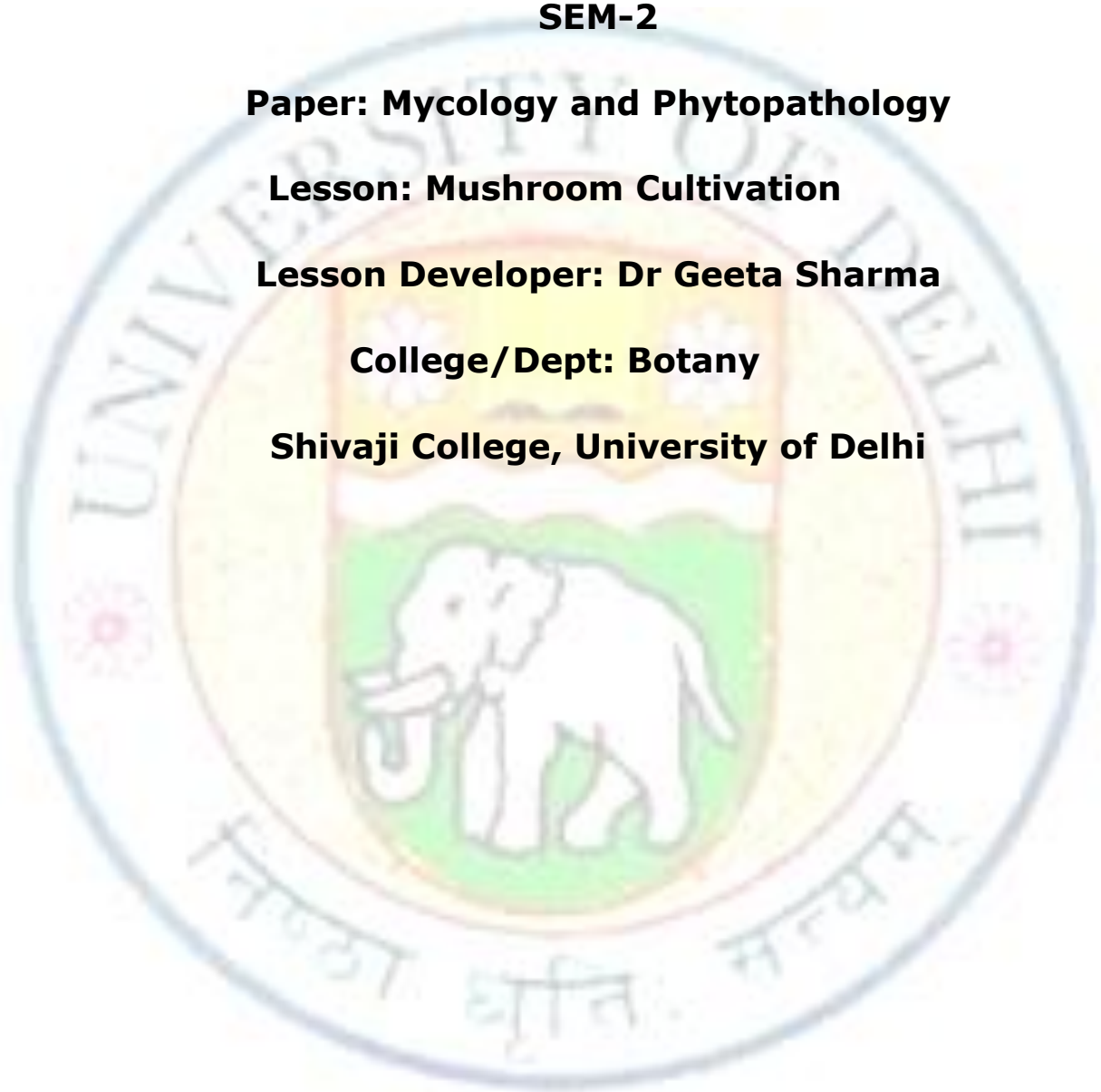


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Introduction

The colourful young bud like stiped fruiting bodies of mushrooms have fascinated the human beings since pre-historic time. They beautify this earth by their presence and appear like colourful unopened floral buds of angiosperms. In nature they inhabit the remote areas of tropical and temperate regions rich in ligno-cellulosic substrata in the soil.

Mushrooms are fungi, fleshy in nature, rich in proteins, minerals and vitamins and can form a rich vegetarian diet full of taste, unique flavour, aroma and nutrition. Mushrooms found in nature are either edible or poisonous and out of 1600 mushrooms identified worldwide, nearly 100 are used as food and 33 types are under commercial cultivation.

In india the mushrooms under cultivation are *Agaricus bisporus* (white button), *Pleurotus* (Oyster) and *Volvariella* spp.(paddy straw) and the sporadic cultivation of *Auricularia* spp. (black ear) and *Calocybe indica* (milky mushroom) has begun in recent years. The commercial cultivation in India have begun in 1971, the annual production of which was 100 tons and now in 2013 it is more than 60,000 tons.



Figure: (clockwise) Fruiting bodies of *Agaricus bisporus*, *Lentinula edodes*, *Pleurotus* spp., *Volvariella pusilla*, *Calocybe indica* *Auricularia judae*.

Source: http://upload.wikimedia.org/wikipedia/commons/f/ff/Champignons_Agaricus.jpg,

<http://upload.wikimedia.org/wikipedia/commons/6/64/Shiitakegrowing.jpg>,
[http://upload.wikimedia.org/wikipedia/commons/7/78/Pleurotus pulmonarius LC0228.jpg](http://upload.wikimedia.org/wikipedia/commons/7/78/Pleurotus_pulmonarius_LC0228.jpg),
http://upload.wikimedia.org/wikipedia/commons/thumb/6/64/Auricularia_auricula-judae_G4_%285%29.JPG/1280px-Auricularia_auricula-judae_G4_%285%29.JPG,
<http://champignonscomestibles.com/wp-content/uploads/2011/08/Calocybe-indica-300x225.jpg>,[http://upload.wikimedia.org/wikipedia/commons/c/c5/Volvariella pusilla_130922w.a.JPG](http://upload.wikimedia.org/wikipedia/commons/c/c5/Volvariella_pusilla_130922w.a.JPG)

In Ramayana mushrooms have been named as Kukarmukta, Romans named them as food of God, Chinese considered them as the elixir of life and Greeks and Romans included mushrooms in their diet since ancient times.

Places of cultivation

In India the mushrooms are cultivated in large scale in Punjab, Haryana (Sonapat), Himachal Pradesh, Solan, Himachal University College of Agriculture, South India etc .In I.A.R.I. Pusa Institute, Mycology department Dr. R.K. Sharma, a senior scientist along with his team have trained many research students, college teachers of Delhi University, farmers and common people to popularize mushroom cultivation, making them aware about their significance as food, raising a crop at a small place in less money and to generate additional source of income by self employment opportunities in rural and urban areas since 2000-2013. The Mushroom Research Laboratories at Solan have excelled in standardizing the techniques for raising *Agaricus* (white button) and Oyster and also helped in establishing mushroom growing centers in Chail, Shimla, Kasauli and 116 other mushroom farms all over the country by supplying mushroom spawns to the growers.

Economic Importance

Mushrooms decompose the agro waste (cellulose, hemicelluloses, and lignin) and organic waste materials and utilize them to produce edible biomass of high nutritive value. Mushrooms are considered in the plant kingdom and are rich in proteins, vitamins, and minerals which can form a purely vegetarian diet with good taste and aroma.

Food value

Cultivated mushrooms are low in calories (135 in 1 kg) rich in proteins, vitamins and minerals. The mushroom fruiting body on dry weight basis contains

Carbohydrates-55%

Proteins -32%

Fat – 2%

Minerals - macro elements - P,K,Cu,Fe

micro elements - Na,Ca,andMg

Vitamins – thiamine (B1),riboflavin(B2), niacin, pantothenic acid (B complex), biotin, folic acid, vitamin C, D, A andK(these are retained even after cooking).

Mushroom proteins contain all the nine essential amino acids basically needed for human growth.It is easily digestible (71 -90%) and 200 gm of mushroom protein = 100 gm of non vegetarian protein (meat).It is an alternative source of protein and can be used for poor people in the developing countries.

Mushroom Cultivation

Contribution to the world / Indian market

The annual production of mushrooms in the world's market is estimated nearly 5-7 million tons in fresh and preserved form and the mushrooms which contribute in it are:

Agaricus bisporus (white button)- 37.7%

Lentinula edodes (shiitake) - 16.8%

Pleurotus spp.(oyster)- 16.3%.

The countries involved in contributing in the world market are:

India - 1% (60,000 tons)

European countries – 55-65%

North America – 27-37%

East Asian Countries – 15-25%.

The consumption rate of world's mushroom produce is:

G-6 countries - (U.S.A.,U.K., Germany,France, Italy, andCanada) - 85%

Rest of the countries - 15%.

The per capita consumption of these countries is 3-4kg.

India`s per capita consumption is 20 - 30 gm.

In India the annual increase of mushroom market is 35 – 45%. The production rate and the consumption of mushrooms is increasing in every season due to the health awareness amongst Indians, but still lot more has to be done to publicize the importance of mushroom cultivation, their food value, income, export potential etc.

In India *Agaricus bisporus* (white button) is cultivated in large scale and it contributes nearly 90 - 95% in the Indian market and the rest comes from *Pleurotus spp.* (oyster) and *Volvariella spp.* (paddy straw).

Growing season

Mushrooms are cultivated through out the year in northern Indian plains and in a particular season:

October to March -----*Agaricus bisporus*(White button mushroom).

May to July-----*Volvariella spp* (Paddy straw mushroom).

Mid August to mid April----*Pleurotus spp.*(Oyster mushroom).

February to April-----*Calocybe indica* (Milky mushroom).

The mushrooms require specific climatic conditions: The R.H. 85-90%,PH 5.8-6.8 and the temperature requirement for the spawn run (mycelium) and fruiting(reproductive bodies) of mushrooms under cultivation are:

Mushroom spp.	Temperature °C	
	Mycelium Growth	Best Fruiting
<i>Agaricus bisporus</i>	22 – 25	14 - 18
<i>A. bitorquis</i>	24 -30	17 -24
<i>Auricularia spp.</i>	20 -34	12 - 30
<i>Lentinus edodes</i>	20 -27	10 -20
<i>Pleurotus eryngii</i>	18 - 22	14 - 18
<i>P.Flabellatus</i>	25 - 32	22 - 26
<i>Volvariella volvacea</i>	20 - 25	28 - 32
<i>Calocybe indica</i>	25 - 35	26 - 30

Sr. No.	State	Button	Oyster	Milky	Other Mushroom	Total production
1.	Andhra Pradesh	2,992	15	15	0	3,022
2.	Arunachal Pradesh	20	5	0	1	26
3.	Assam	20	100	5	0	125
4.	Bihar	400	80	0	0	480
5.	Chattisgarh	0	50	0	0	50
6.	Goa	500	20	0	0	520
7.	Gujarat	0	5	0	0	5
8.	Haryana	7,175	0	3	0	7,178
9.	Himachal Pradesh	5,864	110	17	2	5,993
10.	J&K	565	15	0	0	580
11.	Jharkhand	200	20	0	0	220
12.	Karnataka	0	15	10	0	25
13.	Kerala	0	500	300	0	800
14.	Maharashtra	2,725	200	50	0	2,975
15.	Madhya Pradesh	10	5	0	0	15
16.	Manipur	0	10	0	50	60
17.	Meghalaya	25	2	0	0	27
18.	Mizoram	0	50	0	0	50
19.	Nagaland	0	75	0	250	325
20.	Orissa	36	810	0	5,000	5,846
21.	Punjab	58,000	2,000	0	0	60,000
22.	Rajasthan	100	10	0	10	120
23.	Sikkim	1	2	0	0	3
24.	Tamil Nadu	4,000	2,000	500	0	6,500
25.	Tripura	0	100	0	0	100
26.	Uttarakhand	8,000	0	0	0	8,000
27.	Uttar Pradesh	7,000	0	0	0	7,000
28.	West Bengal	50	50	0	0	100
Union Territories						
1.	A&N Islands	0	100	0	0	100
2.	Chandigarh	0	0	0	0	0
3.	Dadar & Nagar Haveli	0	0	0	0	0
4.	Daman & Diu	0	0	0	0	0
5.	Delhi	3,000	50	20	0	3,070
6.	Lakshadweep	0	0	0	0	0
7.	Puducherry	0	0	0	0	0
Total		1,00,683	6,399	920	5,313	1,13,315

Source: RMCU, DMR, Solan, 2010

Cultivation of (white button) *Agaricus bisporus* mushroom



Figure: Button mushrooms fruiting bodies.

http://upload.wikimedia.org/wikipedia/commons/f/ff/Champignons_Agaricus.jpg,

<http://upload.wikimedia.org/wikipedia/commons/0/01/ChampignonMushroom.jpg>

Agaricus bisporus (=A. brunnescence ; approximately annual yield 2,000,000 t.) is the most favourite amongst other mushrooms under cultivation grown commercially in the world. In India it is grown mostly in large scale in the south, west and northern regions through out the year (to meet the export as well as home demands), in the mushroom houses under controlled conditions to procure nearly 5 crops annually. The seasonal cropping is done from October to mid March to collect one crop, but with specific precautions two crops of 6-7 weeks duration can be taken.

The *Agaricus* being heterotrophic in nature does not need fields (large areas) and direct sunlight for its cultivation like other conventional angiospermous crops. It is cultivated in the large scale in mushroom houses on the substratum like wheat or rice straw supplemented with horse dung, poultry manure, sugarcane bagasse, wheat or rice bran, molasses and chemical fertilizers. All these materials are mixed thoroughly, fermented aerobically and this process is called composting. During this process the nutrients of the raw material used for making the compost get ready to be used to grow and develop the mushroom mycelium and resist the growth of other micro -organisms.

The process of cultivation under controlled conditions and the essential apparatus required to facilitate the composting and cropping of mushrooms is:

- Mushroom house
- Composting yard

- Ingredients and raw material for natural and synthetic compost
- Spawn/ seed of mushroom.
- Casing
- Equipments, accessories and pesticides.

Mushroom house

The button mushroom can be grown indoors in rooms, sheds, garages, basements etc with good ventilation. A good mushroom house should be equipped with the following apparatus:

- It should be in an area free from air pollution.
- It should be well ventilated and made up of insulated walls.
- The ventilators to be fitted with 30 mesh size net.
- The light arrangement of 1500 – 2500 lux intensity.
- The exhaust fan, cooler and air- conditioner.
- It should have pucca floor of either cement or bricks.



Figure: Mushroom house

Source: Courtesy Dr Ajay Yadav. HAIC Murthal Sonapat.



Figure: Mushroom house showing synchrony of button mushroom formation in trays/racks
http://www.doorsofperception.com/archives/Mushroom_Cultivation_2.JPG, Courtesy Dr Ajay Yadav. HAIC Murthal Sonapat.

The racks to be made at least 15 cm apart from the wall and floor of the mushroom house. At the opening of the door of mushroom house a 4-5 cm deep pit of door mat size to be made and to be filled with 4% formalin solution and a jute bag to be put in place of doormat to check pollution from outside during cropping period.

Composting yard



Figure: Preparation of compost

Source: Courtesy Dr Ajay Yadav. HAIC Murthal Sonapat.

Compost is prepared over composting yard i.e. an area where the raw materials like agro-waste, chemicals etc are mixed and fermented. It should have the following:

- It has to be at the corner of the mushroom farm and away from mushroom house.
- A pucca floor of cement or brick.
- A tin shed over the composting yard to avoid rainy water.
- The floor with a slope with the provision of drainage in a pit to reuse that water for wetting of the compost.

Natural and synthetic compost ingredients and raw materials

Natural compost : The natural compost is prepared by fresh horse dung collected from stables mixed with 1/3 weight of wheat or barley straw, 100-110kg chicken manure and 3kg urea per ton and made into a heap of 1meter high. This mixture must be kept under shed and be protected from rain. The horse dung should not contain the admixture of dung from other animals. The heap after 3-4 days begins to steam due to fermentation, rise in temperature and the production of ammonia. The heap is opened and this process is repeated 4 or 5 times at 5 or 6 days interval. Gypsum 25kg/ton of horse dung is added at 2nd and 3rd turning and 40ml nemagon is sprayed at the final turning into the manure. Now the compost is ready to use in mushroom cultivation.



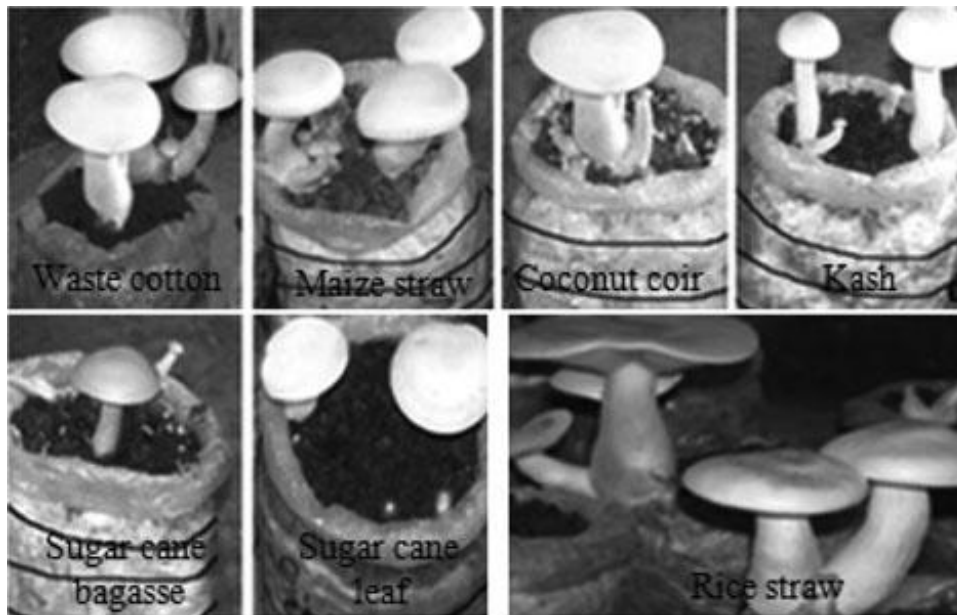


Figure: Different types of natural compost

<http://synapse.koreamed.org/ArticleImage/0184MB/mb-38-97-g001-l.jpg>

Synthetic compost :

This compost is prepared by either long method (traditional) or by short method (pasteurized). The raw materials used for composting (formulae) have been given by different organizations, institutions and workers and can be selected for making compost. here two formulae are given to be used in synthetic compost:

Formula - 1

Material	Quantity
Chopped wheat straw/ paddy straw	250 kg (10 - 15 cm SIZE)
Wheat bran	25 - 30 kg
Ammonium sulphate /CAN(calcium ammonium nitrate)	4 kg
Urea	3 kg
Gypsum	20 kg
Malathion	15 - 20 ml

Formula - 2

Rice straw	1000 kg
Poultry manure	150 kg
Wheat bran	42 kg
Gypsum	30 kg

(If paddy straw is used add 6 kg of cottonseed meal. Straw used in compost should be fresh or one year old only, and not to be exposed to weathering).

Compost preparation

Compost is prepared by two methods i.e. Long method and Short method.

Long method:

- 1 Wheat straw is spread in a thick layer of 8-10" thickness over the floor of composting yard.
- 2 Sprinkle water on the straw for wetting 2-3 times a day for two days.
- 3 Urea, CAN, and wheat bran are thoroughly mixed separately and covered with damp gunny bag for 14-16 hours.
- 4 These ingredients are now mixed with a pre wetted straw on the floor and is heaped into a pile with a stack mould.
5. The entire pile is opened and spread over the composting yard on 3rd or 4th day for 45-60 minutes and this process is called turning which is repeated on every 3rd day. At each turning water is sprinkled to make up the loss of water due to evaporation. At 3rd turning ½ of gypsum amount is added and the remaining gypsum is added on 4th turning. At 5th turning insecticide nemagon is added and thorough mixing of straw is done, later open the pile and leave it for 3 days till ammonia smell is lost.
6. The compost is ready to use in 18-21 days, in which the ligno-protein complex is formed that favours the growth of white button mushroom, also narrows down carbon /nitrogen ratio with the addition of nitrogen sources.

The Short or Pasteurization Method:- the compost is formed in two stages:

Stage 1:

The wheat straw is moistened, mixing of ingredients, making a heap and turning is given in 2 days, gypsum is added after 3rd turning, and after 4th turning the compost is filled in pasteurization tank.

Stage 2:

The temperature 48-50`c is maintained in pasteurization tank for 2-3 days. Steam is passed to raise the temperature to 58-60`c for 6 hours. Fresh air is allowed through ventilation till the temperature of the compost cools down to 25-28`c, and the compost is ready in 19-20 days.

Spawn/seed of mushroom



Figure: Spawn of button mushroom

Source: Courtesy Dr Ajay Yadav. HAIC Murthal Sonapat.

Mushroom seed is called spawn, that is raised from the healthy strains, thoroughly tested and recommended for a particular area or zone. It is the creamish white thread like mycelium of the mushroom growing on the medium (wheat or other cereal grain) that provides it nutrition for its growth. Spawn that is used as seed must be free from contaminants (micro-organisms), fresh or only one month old and can be stored at 5C

The spawn of 160-170 gm is used in one square meter area of the compost of 15-16 cm thickness. The quantity of spawn used at 22-26`c on dry straw is 1-1.5% and 0.50 –0.75% on wet compost. In hills or during winters in plains spawn is required in more quantity i.e. 2.5-3.0% of the dry weight of the straw.

Casing

Casing material is a soil which is, powdered, thoroughly sieved, porous with neutral pH, which allows free exchange of air, also can retain water and is used to cover the compost after spawn run. It is a process of covering the spawn run compost with casing soil to initiate fruiting (due to shock treatment), to support the fruiting body and to check the loss of moisture from mushroom compost.

The examples of casing materials which can be used in initiating fruiting are:

Farm Yard Manure (FYM) + 2 – 3 years old spent compost (1: 1).

F Y M + Loamy soil 1:1

FYM+ loamy soil + spent compost (1:1:1)

Peat moss + soil (2:1v/v)

Garden soil+FYM(2:1)

Vermicompost + loamy soil(1:1)

Spent compost +FYM + clay soil (2:1:1)

The casing materials are powdered and thoroughly sieved, FYM one year old and spent compost of two year old are sterilized either by passing steam at 56 -60 `c for 4 -6 hours or at 80`c for 2 hrs or by treating it with 40% formalin to kill nematodes, insects and other harmful micro-organisms before use. This treated material is piled up in a heap and covered with another plastic sheet for 48-72 hours. This casing material is stirred for one week to remove the formalin odour and now it is ready to use.

Equipment, accessories and pesticides

Mushroom trays, foot sprayers, sharp knife, gunny bags, water storage drums, plastic/alkathene sheet, water pipe and insecticides etc. These equipments are used in mushroom house in various ways.

Process of Cultivation

The seasonal sowing of white button mushroom (*Agaricus bisporus*) is done during October to mid of March in Delhi, Haryana, Punjab, Rajasthan and Uttar Pradesh. The recommended strains of *Agaricus bisporus* are P-1, S-11, Pant -52, NCS-5, NCS-14, S-310, MS-39 etc. *A.bitorquis* is used in areas where temperature 14-18`c does not remain at least for one month in winter season.

Compost preparation is completed in the last 20 -25 days of September and Wheat and paddy straw are best substrates for *Agaricus* cultivation. The compost ready for spawning is dark brown in colour, without any odour of ammonia and has sufficient moisture when pressed between the palms.

Filling of the compost

The prepared compost is filled in trays and racks of 6-8" thick layer, lightly compressed and levelled. The four racks can be kept one above the other by keeping 45-50 cm distance between two racks for ventilation and other functions. The lower rack must be 20-25 cm above the floor and the uppermost rack should be 100-125 cm distant from the roof of the mushroom house.

The compost is filled in 12-14 " thick layer in polybags(45#60 cm size)and 2mm diameter hole at a distance of 5 cm is made in polybags and the mouth is tied.

The compost is treated with 500ppm bavistin before spawning.

Spawning

Sowing the beds with the mycelium(spawn) is called spawning. Spawn is available at a nominal cost from Mushroom lab., College of Agriculture, Chamba Ghat, Solan-173213. Small quantity of spawn is also available from the head, Div. of Mycol. and Plant Path., I.A.R.I., New Delhi. The grain spawn is scattered all over the surface of the compost in trays or racks and it is covered with 2 cm thin layer of compost. Two half liter spawn bottles are sufficient for 5 trays.

Preparation of mother spawn (Source: Mushroom cultivation, Marketing and Consumption) Director Directorate of Mushroom Research (ICAR) Chambaghat,

Solan –173213 (HP)

About 300 g prepared substrate (boiled grains mixed with gypsum and chalk) is filled in glucose/milk/glass bottles upto 2/3 volume and plugged with non-absorbent cotton. The plugs are covered with aluminum foil. These bottles are then autoclaved at 22 p.s.i. pressure for 1.5 to 2 h. Autoclaved bottles are left in the room for 24 hours for cooling and are kept on laminar flow under U.V. tube for 20-30 minutes before inoculation. A piece of mycelium (pure culture) grown in Petri plates is aseptically transferred to these bottles and inoculated bottles are

incubated (for incubation temperature refer Table 5.1). These bottles are gently shaken on 5th and 10th day for distributing the inoculum evenly in the bottles. The spawn prepared using pure culture mycelium as inoculant is referred as mother spawn (Fig. 5.5). Fully colonized mother spawn bottles can be used for inoculating commercial spawn bags after two to three weeks.





(a) Boiling, sieving, autoclaving and inoculation



(b) Method of inserting ring, folding bag and plugging



After spawning the trays are covered with old newspaper sheets and watered lightly with sprayer to provide moisture. The trays are then stacked vertically one over the other in 3-4 tiers. In bag cultivation, bag mouth is tied with thread or sutli.



Figure: Inoculation of spawn on wheat/rice straw

http://farm9.staticflickr.com/8314/8064680803_d19de8b616.jpg

Spawn running: The temperature and relative humidity of the mushroom house where trays or bags are kept is maintained at 22-26`c. and RH 80-85%.The humidity is maintained by frequent spraying of water on walls and floors of mushroom house. The mushroom house is kept closed and increased CO2 level helped mycelial growth within 14-15 days of spawning. The compost surface is covered with cottony growth of white mycelium and this condition is called completion of mycelial run or spawn run. Low temperature does not harm the spawn running but prolongs its spread.



Source: Courtesy Dr Ajay Yadav. HAIC Murthal Sonapat.

Casing:

The casing is done after the completion of spawn run and removal of news paper from trays or racks and opening of mouth of polybags with 4-5 cm thick layer of casing soil. After casing water is sprayed over casing soil and the temperature and relative humidity is maintained at 24-25`c, and RH 80-85% for 4-5 days. Once the mycelium spreads in the casing soil, the temperature is lowered at 14-18`c and RH 80-85% till rest of the fruiting period.

Fruiting/crop :

The induction of bud primordia or pin heads or fruiting bodies on the casing soil is observed after 15-20 days of casing. The casing layer is frequently wetted with mist spraying of water. At this stage large amount of fresh air is required. The temperature 14-18`c and R.H. 80-85% is maintained in the mushroom house. Within 4-5 days fruiting bodies attain the shape of white buttons.

Harvesting:

The harvesting begins when the cap size is 3-4cm in diameter. The right stage of harvest is when the cap is still tight and membrane below the cap is intact over the short stipe. In case the buttons are allowed to mature further the cap will rupture, dark coloured spores will be exposed and mushrooms become inferior and loose market value. Pre-harvesting spray of 2% ascorbic acid improves the colour (whiteness) by inhibiting the polyphenol oxidase enzyme activity.

Picking is done by holding the cap with fore fingers slightly pressed against the soil and rotating it in anticlock-wise. The soil particles and mycelial threads clinging to the base of the stipe is removed with knife. Harvesting is also done with knife by cutting the stipe at the soil level.





Yield:

The yield in bag cultivation method is 10-15 kg/100 kg of compost and 16-20 kg /100 kg of pasteurized compost in 6-8 weeks time. The average yield of 6-8 kg/ meter is obtained in 6-8 weeks. However , the yield may be 10-12 kg/meter if compost is good, spawn of good quality and favourable temperature and R.H. during growing period is maintained in the mushroom house. Partial or complete failure may also happen due to negligence.

Washing

The harvested crop of mushroom is immediately dipped in cold water (5⁰C).

The dipped mushrooms are taken out from cold water and washed in running water.



<http://agrosysindia.com/wp-content/uploads/2013/06/16.-Washing-mushrooms-Post-to-the-Harvest.jpg>



Courtesy Dr Ajay Yadav. HAIC Murthal Sonapat.

The washed mushrooms are dipped in cold water solution containing 0.05-0.1% citric acid or tartaric acid or 0.025-0.5% potassium metabisulphited solution.

Treated mushrooms are dried in shade over muslin cloth.

Packing :

Packaging is done in 200gm or 500 gm polythene bags or plastic containers. For local market packaging is done in non-perforated bags and for storage 0.5 % perforation is done.



Courtesy Dr Ajay Yadav. HAIC Murthal Sonapat.

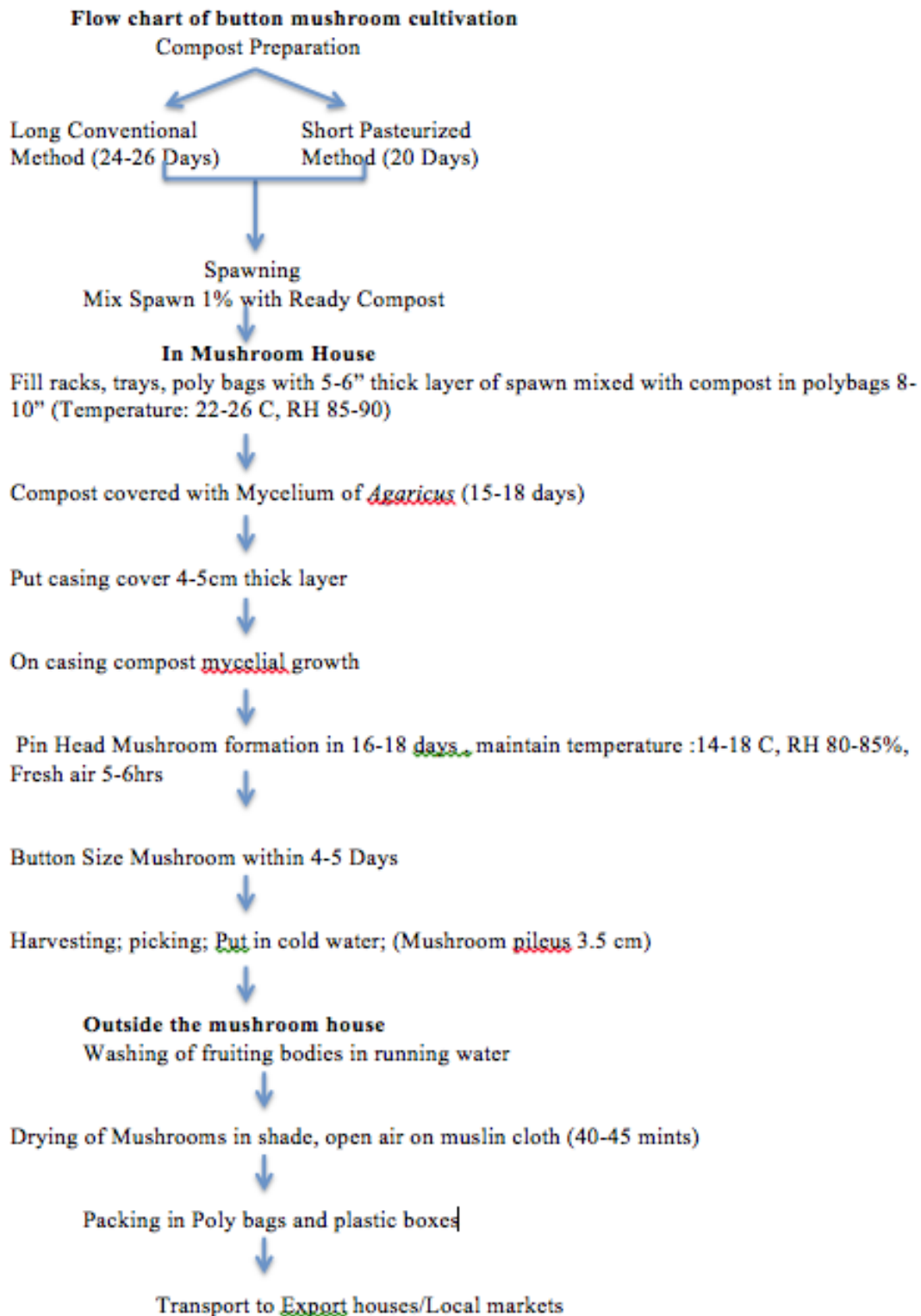


<http://cdn1.wn.com/ph/img/40/8a/462e53553ea465a6c801f901f04b-grande.jpg>

Storage :

The storage life or shelf life of button mushroom is very less i.e. one day at ambient temperature and they can be stored at 5`c for 3-4 days only. During peak season the bumper crop is either exported immediately or is preserved by canning. The canned

mushroom can be consumed up to 8-10 months.



Summary

The mushroom cultivation involves the production of edible basidiomycetous fungi under controlled environment provided in the mushroom houses. The selected edible mushrooms are rich in nutrients that are needed by human-beings for their growth, development and healthy life. Amongst the mushrooms under cultivation, the most common, delicious, lovable, easy to grow and in prime-demand is a genus *Agaricus bisporus* (*A. brunnescence*) commonly called white button mushroom. It contributes nearly 90 -95 % commercially in the Indian market and 0.75-0.8% in the world market and the rest is contributed by *Pleurotus spp.* (oyster) and *Volvariella spp.* (paddy straw) etc. It is grown seasonally as 1-2 croppings between the main crops of cereals and in the large scale as 4-5 croppings as main crops in the mushroom houses by the rich farmers under controlled environment for export and home consumption in Delhi and outskirts of Delhi i.e. Sonapat, Haryana and in hilly areas i.e. Shimla, Solan etc. This rhizomatous group of mushrooms is eco-friendly as it utilizes agrowaste (wheat and rice straw from the fields after harvesting), animal waste (horse dung and poultry manure) and factory waste (sugar cane bagasse, molasses, wheat and rice bran) and convert them into edible biomass of high nutritional value to be used in food and medicines by man. The mushroom house waste is recycled by using it as animal feed (rich in proteins, vitamins and fibre), as fertilizer to improve the texture of the soil and convert the barren & waste lands into fertile lands. Hence mushroom cultivation provides food and nutrition, medicines, naturally recycled edible biomass, animal feed, ready-made rich nutritional manure, an opportunity for self employment to the youth and housewives to raise additional income and lastly it helps in earning foreign exchange.

Exercises

Comment on the following statements:

- a) Mushrooms are eco-friendly.
- b) Mushroom cultivation enhances the economy of the country.
- c) Spawn or seed of mushrooms.
- d) Climatic conditions in the mushroom house during button stage.
- e) Compost preparation.
- f) Edible mushrooms
- g) Economic importance of mushroom cultivation.

Glossary

Basidiocarp: A spore producing body that bear basidia (fruiting body).

Basidiospore: A meiospore borne externally on the basidium following karyogamy and meiosis.

Basidium: A structure bearing a definite number of basidiospore (typically four) on its surface following karyogamy and meiosis.

Spawn: The secondary mycelium, haploid, binucleated heterokaryon(+&-), used in the commercial production of mushrooms.

Spawning: Inoculation (placement) of the spawn in to the substratum (compost), on which mushrooms will grow.

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