Progress Report AY 2023-24

On

Establishment of Commercial Cultivation of Mushroom Unit by School of Agricultural Sciences in collaboration with the KEIC Foundation

Date: December 2023 onwards

Venue: Farm, School of Agricultural Sciences

Event Type: Entrepreneur Skill Development

Mode of Activity: Offline

Organized by: School of Agricultural Sciences in collaboration with the KEIC Foundation

Participants: Students, SOAS

Faculty organizers: Dr. Deepak Kumar, Assistant Professor, SOAS

Convener: Prof. (Dr.) J. S. Yadav, Dean, SOAS

Number of Participants: 04

Introduction:

The production of edible mushrooms or other mushrooms has increased by 30 times during the last 35 years. The reason for this growth is improved farming techniques, increasing exposure to generally improved varieties of mushroom production, health promotion, and processing. In the early 20th century, success was achieved in making pure cultures from the issues and microscopic spores of button mushrooms. This was the first step in the scientifically commercial cultivation of mushrooms. This gave a boost to the cultivation of button mushrooms. The second major milestone was the success of small methods of composting around the year. The third stop was in 1981, when the first hybrid variety of mushroom, U-1, was introduced in 1950. It was successful. At present, mushrooms are being grown in more than 100 countries for their nutritional and medicinal qualities and excellent means of income. Mushrooms are an important horticultural cash crop. Biologically, it is a type of fungus.

Its fruit is a fleshy filamentous body that is grown on humus soil, wood, sawdust, straws, etc. Mushrooms are mostly grown in close and dark rooms. These crops give attractive profits as compared to other crops grown in agricultural fields. Mushroom production in the world is

about 4 million tons per year and is increasing at a rate of 8–10 percent per year. We know that the first mushroom cultivation in India was started in the 1960s in the Solan district of Himachal Pradesh. Mushroom cultivation was successful in the 1970s in the northern region of India, with cold fields in Uttarakhand, Tamil Nadu, and Himachal Pradesh. Now, all over India, farmers are getting involved in mushroom cultivation day by day. In India, commercially cultivated species are button mushroom and oyster mushroom (85%), followed by paddy straw and milky mushroom.

Extensive research on mushrooms started after the establishment of the Directorate of Mushroom Research in 1983. The emergence of a new, improved variety of button mushroom helped increase production in the 1990s. A mushroom is a functional food that contains various medical components and is rich in vitamins and minerals. It is a good source of protein and a vegetarian source of vitamin D. They are an aggregate of agricultural and industrial waste. These wastes can be effectively used for the production of mushrooms. High-yielding varieties of edible mushrooms were released in India. Mushroom cultivation has become an increasingly important sector in modern agriculture due to its high nutritional value, rapid growth cycle, and potential for profitability.

Inaugural Ceremony

The establishment of commercial cultivation of mushroom units began in December 2023 by the final-year students (batch 2020–24) of B.Sc. (Hons.) Agriculture. Prof. Ankush Mittal, Hon'ble Vice Chancellor, K R Mangalam University, inaugurated the commercial cultivation mushroom unit established at the agriculture farm. It is the first venture of the School of Agricultural Sciences in collaboration with the KEIC Foundation, inspire from Hon'ble Chairman Mr. Abhishek Gupta and Worthy Vice Chancellor Prof. (Dr.) Ankush Mittal. The chief guest was welcomed by Shri Dayachand Ji, a progressive farmer with rich experience in mushroom production. This venture was started by Mr. Aamir Khan, Ms. Poonam, and Ms. Sheetal, and other students of BSc (Hons) Agriculture, as founders under the mentorship of Dr. Deepak Kumar, Assistant Professor, and the overall guidance and mentorship of Prof. J. S. Yadav, Dean, School of Agricultural Sciences. About 100 packets of organic mushrooms were sold at the inaugural price of Rs. 35 per packet. Dr. Meenakshi Gujral, KRMU International Relations, and students from various schools of the university also joined the ceremony.

The commercial cultivation of button mushroom operated in the AY 2024-25 by the students of 2021-25 batch in collaboration with the KEIC Foundation. Students also grow dhingri mushrooms (Photo 2) at the K. R. Mangalam University campus as well in the summer session.

Dhingri mushrooms (Pleurotus spp.) are widely cultivated in India due to their adaptability, ease of cultivation, and use of agro-waste as substrate. These mushrooms require relatively simple cultivation techniques, exhibit fast yields, and can be grown on various substrates. They offer nutritional and medicinal advantages, including protein, low fat content, and natural compounds like lovastatin, which have health benefits.

Photo 1: Inaugural Ceremony Commercial Cultivation Unit at SOAS, K. R. Mangalam University

This report provides an in-depth analysis of the commercial mushroom cultivation of button mushrooms initiated by students at the School of Agricultural Sciences, K R Mangalam University, Gurugram, Haryana. It covers various aspects, including mushroom types, cultivation techniques, environmental requirements, economic considerations, and challenges.

There are mainly five commercial varieties of mushrooms grown in India.

1. Button mushroom
2. Dhingri mushroom

3. Straw mushroom
4. Milky mushroom
5. Shiitake mushroom

Button Mushroom-

Button mushroom is a popular to be grown, which can produced in environment controlled unit as well as in non-environment controlled unit. Presently it is cultivated by environmentally controlled units in U.P., H.P., A.P., Delhi, T.N. Punjab and Haryana, Uttrakhand and Karnataka.

Dhingri Mushroom-

It is the most popular mushroom. The cultivation of dhingri mushroom can be done on a large scale on gain straw, sugarcane bagasse, jute, cotton, corn and sawdust as well on groundnut shells and dry grass etc. These mushrooms are pasteurized by various techniques like as hot water treatment steam pasteurization, chemical sterilization techniques etc.

Photo 2: Dhingri Mushroom Cultivation at SOAS, K. R. Mangalam University

Straw Mushroom-

It has very short life cycle and maximum grown in odisha state. It can be successfully produced in high humidity areas at 30-35◦C temperature. Paddy straws are required for growing purpose.

Milky Mushroom-

These are suitable for hot area. Milky mushroom are popular in Tamil Nadu, Andhra Pradesh and Karnataka. These mushrooms are best used for making pickles. Its production can be up to 30-35◦C. Because of this it can be successfully produced in areas with hot climate.

Shiitake Mushroom-

These are world's no.1 mushroom to be grown. Main reason for growing these mushrooms for medical properties. These are grown on sawdust of broad-leaved tree. Fruiting temperature is 15-24◦C and autoclave is required for its sterilization.

Components:

- Species Selection: Identify the most suitable mushroom species for commercial cultivation.
- Infrastructure: Outline requirements for setting up the cultivation facility.
- Cultivation Process: Detail the methods and techniques for successful mushroom farming.
- Conclusion.

A. Species Selection

Button Mushrooms:

Button mushrooms (Agaricus bisporus) are among the most popular and widely cultivated mushrooms in the world. Known for their versatility, mild flavor, and nutritional benefits, button mushrooms are a staple in many cuisines. They are also relatively easy to grow, making them a popular choice for both commercial and home cultivation.

Photo 3: Button Mushroom

Scientific Name: Agaricus bisporus

Varieties: Includes white button mushrooms, brown cremini mushrooms, and mature Portobello mushrooms.

Characteristics: Button mushrooms have a mild flavor and a white to light brown color. As they mature, they develop a larger cap and deeper flavor.

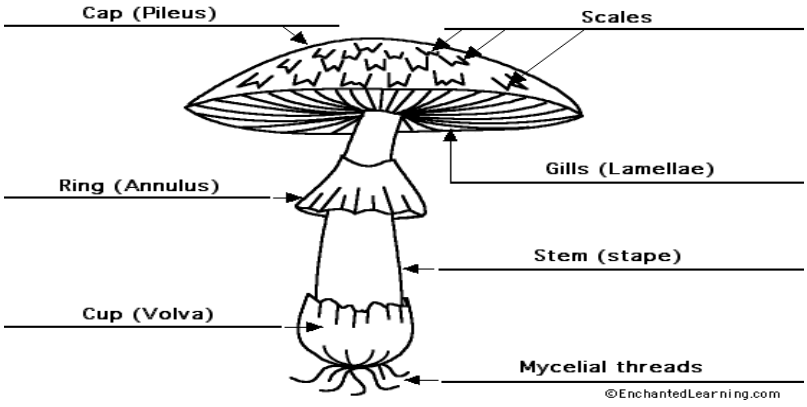


Photo 4: Structure Button Mushroom

Importance of Button Mushrooms

- **Culinary Uses:** Button mushrooms are used in a wide range of dishes, from salads and soups to stir-fries and pizzas. Their mild taste makes them versatile and popular in various cuisines.
- **Nutritional Benefits:** Rich in vitamins (such as B vitamins), minerals (like potassium and selenium), and antioxidants. They are also low in calories and fat.
- **Economic Value:** Button mushrooms are a significant crop in the mushroom industry, providing income for commercial growers and hobbyists alike

B. Infrastructure and Equipment

i. Facility Requirements

- Site Selection: Choose a location with stable climate conditions and easy access to water and utilities. Ensure the site is free from contamination sources.
- Facility Design: Design the facility with separate zones for substrate preparation, incubation, fruiting, and storage. Ensure proper ventilation and sanitation areas.

ii. Mushroom growing structures: Creating the right environment for mushroom cultivation is crucial for successful production. The structure of the growing area can significantly impact yield, quality, and efficiency and economically affordable.

Photo 5: Permanent Structure

Photo 6: Preparation of Temporary Structure at Agriculture Farm

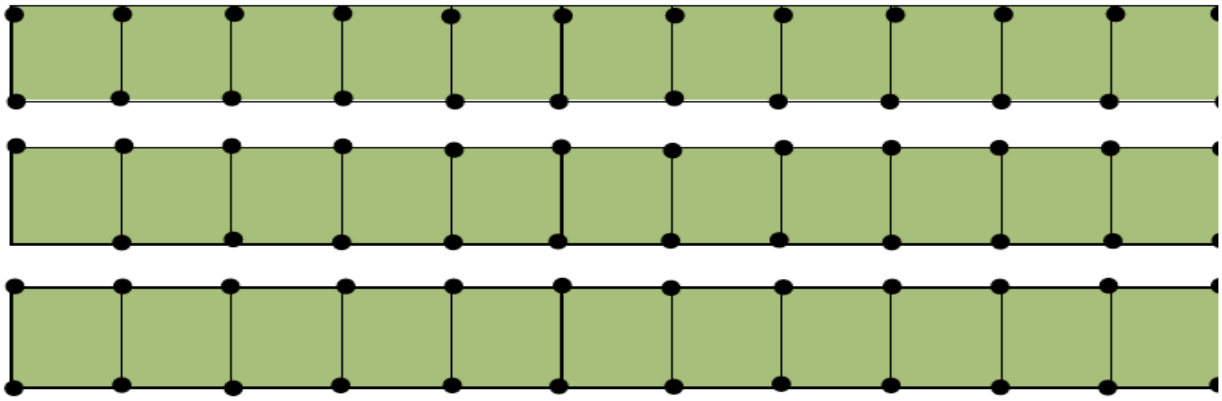


Photo 6: Layout of mushroom cultivation unit

iii. Equipment

- Climate Control: Invest in heating, cooling, and humidity control systems to maintain optimal conditions for each stage of cultivation.
- Substrate Preparation: Acquire pasteurizers or sterilizers for substrate treatment. Consider bulk substrate preparation systems.
- Fruiting Chambers: Use controlled environment chambers or rooms with adjustable temperature and humidity settings.

- Monitoring Tools: Install sensors and monitoring systems for temperature, humidity, and CO2 levels.

Photo 8: Equipment's and other material required to maintain the environment

iv. Environmental Requirements

- Temperature: Button Mushrooms: 24-26°C during colonization; 16-18°C for fruiting.
- Humidity: High Humidity: Essential during the fruiting phase to prevent drying out and promote mushroom growth. Relative Humidity: 80-90% recommended for most species.
- Light: Low Light: Mushrooms do not require light to grow, but a light source can help improve the quality and yield of the fruiting bodies.
- Air Circulation: Ventilation: Adequate air exchange is crucial to prevent the buildup of carbon dioxide and maintain healthy mushroom development.

C. Cultivation of Button Mushroom

Button mushroom can be grown anywhere if the essential conditions are obtained or controlled.

The whole process of mushroom production can be divided into-

- Spawn production
- Substrate Preparation

- Spawning
- Spawn running
- Casing
- Disease Management
- Fruiting
- Harvesting and Packaging

I. Spawn production

Spawn is seed of mushroom Spawn production is done from pure culture of selected strain of mushroom under aseptic condition. Spawn production is a crucial step in button mushroom cultivation. Spawn is essentially the inoculated substrate that will be used to grow the mushrooms.

II. Substrate Preparation

Composting: For Agaricus bisporus, a mixture of straw, manure, and gypsum is composted and pasteurized.

Compost preparation: Composting methods

a) Long day method

b) Short day method

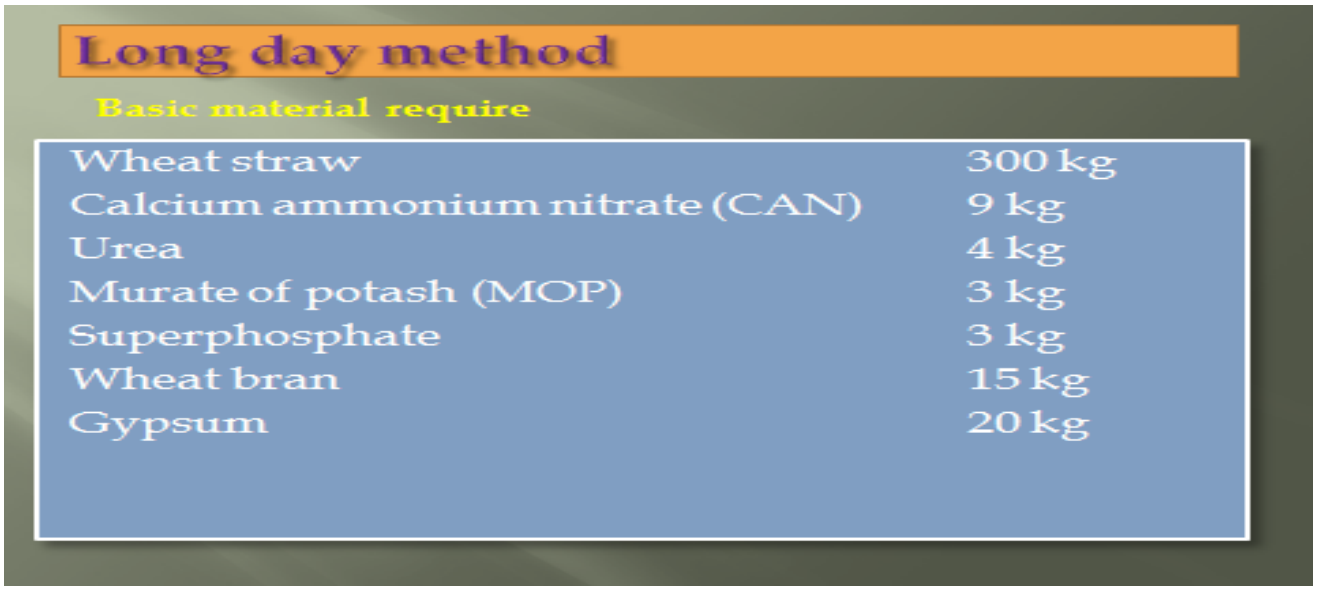


Photo 9: Material required for long day method

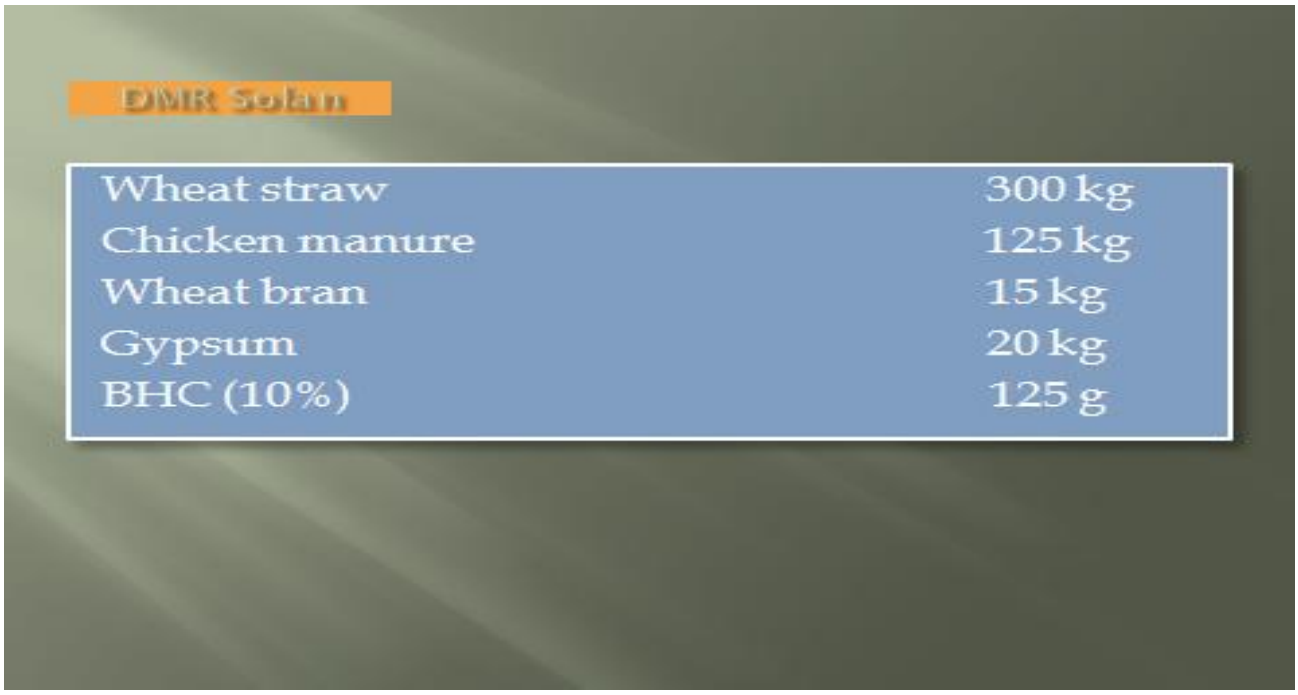


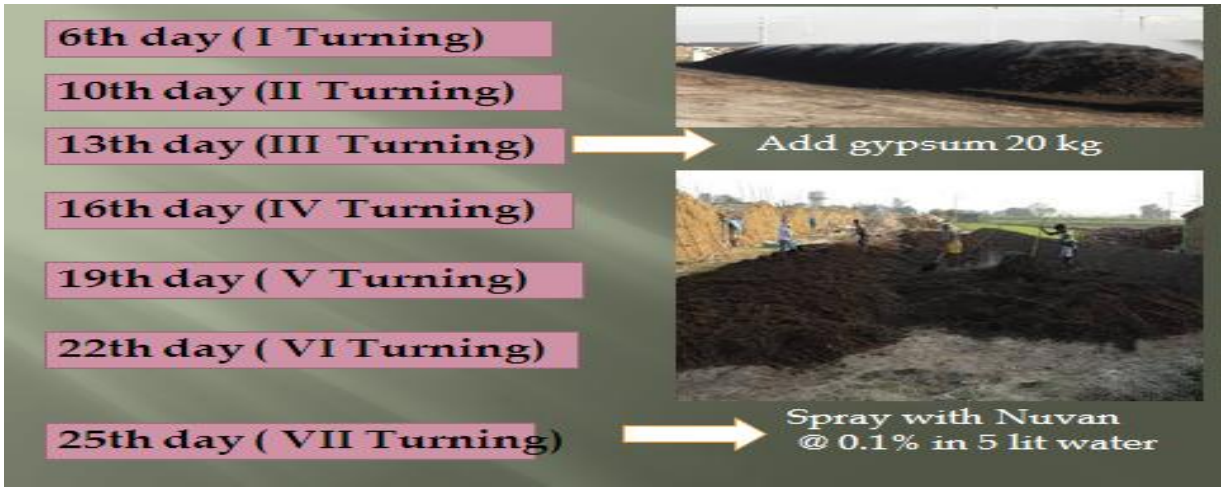
Photo 10: Directorate of Mushroom Research

Photo 11: Activities performed during mushroom cultivation

Process of composting: Spread on the concrete floor for 48 hours and wet the straw fully.

0 Day: -

- Spread the wet straw in 1ft. layer and put all ingredient and mixed thoroughly
- After that make a heap
- After 48 hours of heap formation temperature will start rise and reaches to 70-75 degree Celsius.



III. Spawning

Spawning is the initial step in mushroom cultivation where you introduce mycelium into a bulk substrate. This process is crucial before you apply the casing layer. Here's how spawning integrates with the casing stage and how it impacts the overall mushroom cultivation

Shifting of bags into growing chamber: Before shifting of bags, treat the chamber floor, walls and rack with 2% formalin. Also spray the chamber with 0.1% Nuvan before 2 days, Maintain the room temperature 22-25 ^{0}C and 80-90% RH for spawn running.

Photo 12: Bags into growing chamber

IV. Spawn running

Spawning is a crucial step in mushroom cultivation where inoculated substrate (spawn) is used to propagate mushroom mycelium into a larger growing medium. Here's an in-depth look at the spawning process. Spawn is the mycelium (the vegetative part of the fungus) grown on a

carrier material like grains or sawdust. It acts as the inoculum that will colonize a bulk substrate.

Monitoring: The mycelium will start to colonize the substrate. This can take anywhere from a few days to several weeks, depending on the mushroom species and environmental conditions. Monitor for any signs of contamination, such as unusual colors, odors, or mold.

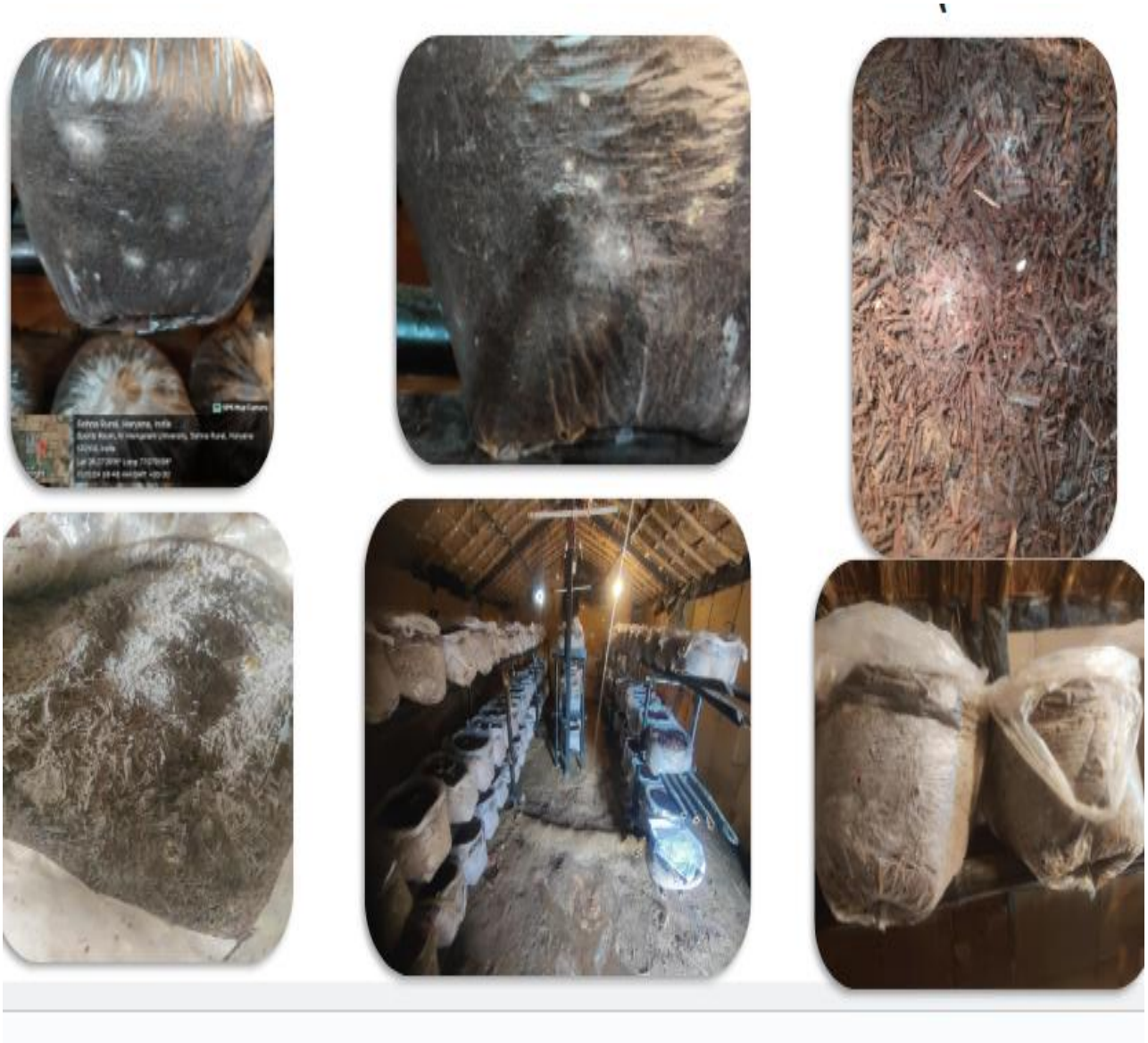


Photo 13: Mycelium Development Stages

V. Casing

Casing is an essential step in the cultivation of many mushroom species, including the button mushroom (Agaricus bisporus) and some other types like the oyster and shiitake mushrooms.

It involves adding a layer of material over the colonized substrate to create a suitable environment for the development of mushroom primordia (the initial stages of mushroom formation). Here's a comprehensive guide on casing.

Photo 14: Casing Preparation by the students

Casing Involves following steps: -

- The compost beds after complete spawn run should be covered with a layer of soil (casing) about 3-4 cm thick to induce fruiting
- The pH casing material should range between 7-7.5
- Casing is done after 12-14 day of pawning
- The casing soil should be treated with formaldehyde (2%) and steam sterilized
- After casing is done the temperature of the room is again maintained at 22-24^{0}C and relative humidity of 85-90% for another 8-10 days
- Low CO_2 concentration is favorable for reproductive growth at this stage.
- 2-3 light sprays of water per day for moistening the casing layer, maintain moisture level

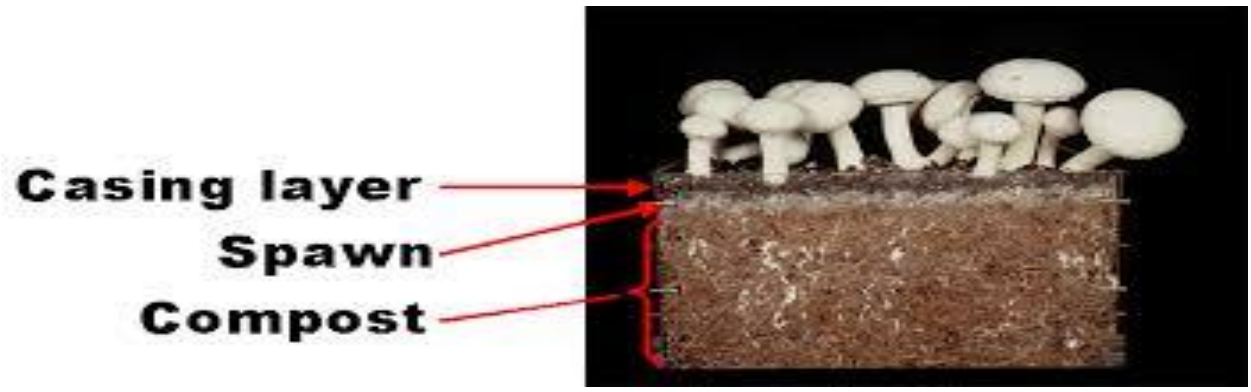


Photo15: Role of Casing in Mushroom Developmental Stages

VI. Disease Management

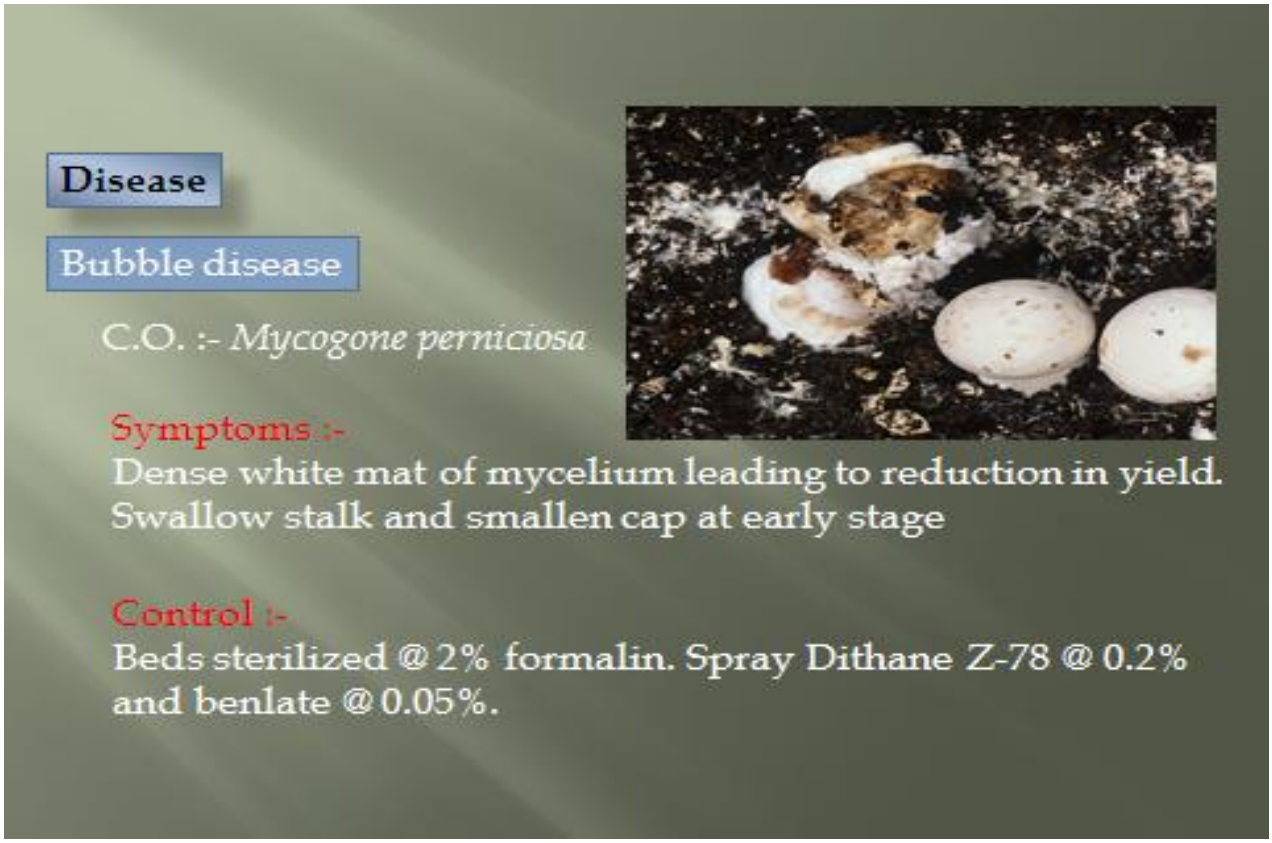


Photo 16: Mushroom Bubble Disease

Photo 17: Mushroom Dry Bubble Disease

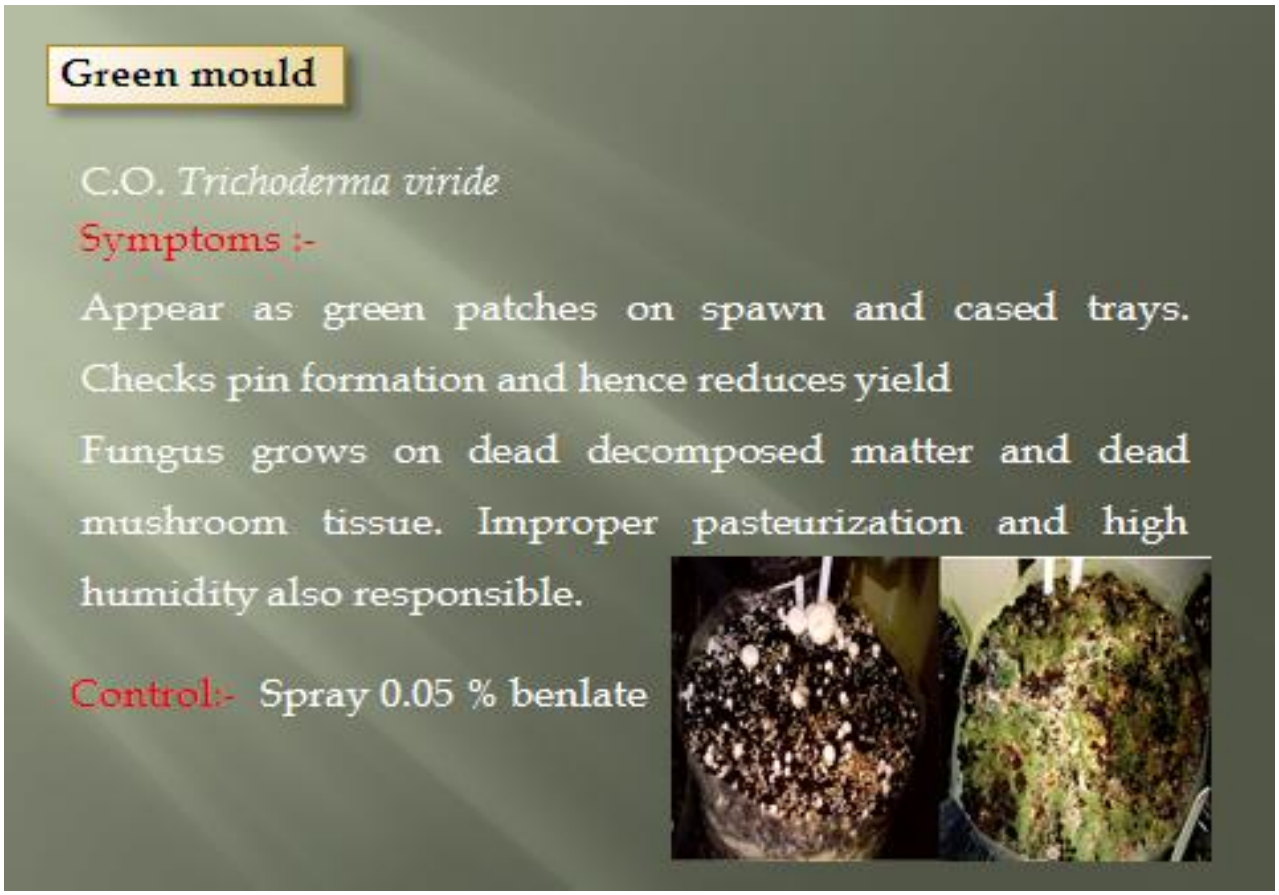


Photo 18: Mushroom Green Mould Diseas

VII. Fruiting: After spawn fully run in casing soil, the room temperature should be down (16- 18^{0}C) to induce fruiting. Temperature decrease by induce fresh air into growing chamber. Prymodia formation (after 2-3 days of decreasing tem.).

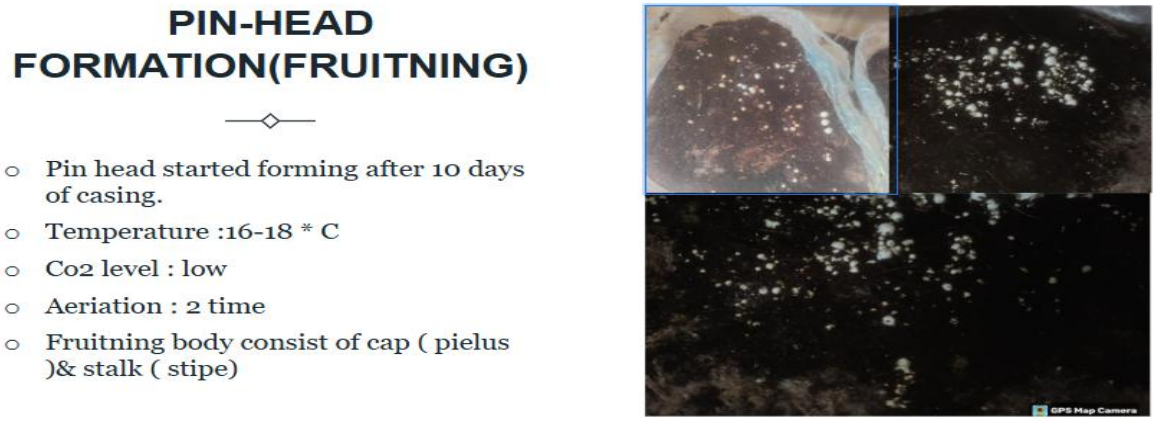


Photo 19 : Fruiting Stage of Mushroom

VIII. Harvesting and Packaging

The ideal time for harvesting is when the mushrooms reach a uniform size of 3–5 cm in diameter. Harvesting is done manually by gently twisting the mushroom to separate it from the compost without damaging the nearby mushrooms. The base is trimmed with a sharp knife to remove any attached soil or substrate particles. Immediately after harvesting, mushrooms are sorted based on size, quality, and appearance. Damaged or discolored mushrooms are removed. Due to their high moisture content and perishability, proper packaging is essential to maintain freshness and market value. Mushrooms are packed in perforated plastic trays, punnets, or boxes lined with food-grade film to allow air circulation and prevent condensation. Common packaging materials include polyethylene or polypropylene with perforations.

For extended shelf life, mushrooms should be kept at a temperature between 0–4°C. Cold chain management during storage and transportation is critical to avoid spoilage. Proper harvesting and hygienic packaging not only preserve the visual appeal and quality of button mushrooms but also enhance their marketability and consumer acceptance in both local and export markets

Photo 20: Harvesting of Mushroom

Photo 21: Packaging of Mushroom

E. Conclusion

Mushrooms are the future main crop of the country, and the scope of their growth in production is tremendous. The growth of mushrooms will depend on their domestic consumption and exports. Presently, North India is facing a major problem with the burning of agricultural residues. Mushrooms are the best solution to this problem. There is a good combination of technical and non-technical manpower required to conduct mushroom-growing activities in India. The cultivation of both Button and Dhingri (Oyster) mushrooms at the School of Agricultural Sciences offers valuable experiential learning for students in sustainable agriculture. These two varieties represent different climatic and cultivation needs, providing diverse technical training in substrate preparation, spawn inoculation, harvesting, and packaging. Through hands-on exposure, students gain insights into cost-effective, high-yield crop production that requires minimal land and inputs. This practical knowledge fosters entrepreneurship, enhances livelihood opportunities, and promotes eco-friendly farming practices.

The School of Agricultural Sciences at K R Mangalam University has a long-term vision to extend the production of mushrooms on a large scale in the upcoming years, enhance the skills of students in mushroom cultivation as well as the value addition in mushroom products, and guided students to become successful entrepreneurs.

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