**National Education Policy 2020 (NEP-2020)**

**E-Content for Botany of B.Sc. Ist Sem (Microbiology & Plant Pathology Course Code: B040101T Unit-V Mushroom Cultivation), M.Sc. IIIrd Sem Elective Paper, Paper code BOT3004E1.3, Unit-IV Button Mushroom Cultivation**

**developed by**


**Dr Rajesh Kumar Pandey, PhD, NET, FSPPS, FIPS,**

**Assistant Professor**

**Department of Botany Bundelkhand University Jhansi Uttar Pradesh**

**Email: rkp_vam@rediffmail.com**


**Cultivation of White Button Mushroom (*Agaricus bisporus*)**

Button mushroom cultivation has two major components, composting (preparation of substrate/compost), and the crop management, (raising of mushroom crop). The substrate preparation has undergone scores of innovations/improvements suiting environment protection laws in many developed countries. At the same time, casing medium has also been standardized with use of peat and its alternative materials (FYM, Spent Mushroom Compost and Coir Pith) with prime objective to improve productivity and quality of mushrooms. Similarly, the crop management techniques have also been improved upon to harvest highest possible mushroom yield over a shortest period of time. All the operations/applications done after completion of composting are handled under the head crop management.

These include:

A. Agronomic crop management

B. Environmental crop management

**A. Agronomic Crop Management**

Agronomic crop management deals with the compost quantity to be filled per m2 bed area, moisture content of compost, spawning method employed, compost thickness in a bed or bag, casing application and thickness, watering regimes employed, harvesting of crop and after care, pest management, hygiene maintenance and so on. However, more important among these are

1. Spawning and spawn run

2. Casing materials, casing treatments, casing application, case run and pinhead formation

**1. Spawning and spawn run**

● Good quality compost with temperature of 25°C

● Mixing of grain based spawn (@ 0.5-0.7% of wet compost weight) of A.bisporus under clean conditions (i.e. with clean hands and pre-sterilized area)

● Filling of spawned compost into polythene bags (12-15'' depth) or beds (6-8'' depth)

● Little compressing and levelling of spawned compost

● Loosely closing the mouth of polythene bags filled with spawned compost (Covering with a clean newspaper / plastic sheet if filled in trays/shelves)

● Shifting the compost filled bags in cropping rooms with a temperature of 23 ± 1°C (air temp.), RH of 95% and high CO2 conc. (1.0-1.5% strain dependent), and keeping the bags under above conditions for 12-14 days

● Completion of spawn run (change of dark brown compost mass in to light brown colour)

Precautions

● Use of fresh pure culture spawn

● Spawning under clean conditions (preferably under positive pressure created using bacterial filters before inlet fans and air curtains at doors)

● Proper treatment of spawning area and tools with formalin, and cleaning of hands with dettol

● Maintaining good hygienic conditions during spawning by keeping all the doors/ windows closed

**2. Casing and case run**

Casing is a 3-4 cm thick layer of soil applied on top of spawn run compost and is a pre-requisite for fructification in A. bisporus.

**a. Casing materials**

Earlier sub-soil material or organic matter rich soils were used as casing in button mushroom cultivation. Presently peat is the most desirable casing material used world wide with excellent mushroom yields and superior fruit body quality. However, pest is not available in India. The other alternative recommended materials are,

● Well decomposed Farm Yard Manure (FYM) preferably two years old

● Well decomposed Spent Mushroom Compost (SMC) (two years old anaerobically decomposed)

● Composted coir pith (coir industry waste) (well decomposed & water leached)

● 1:1, 2:1 and 1:2, v/v of well decomposed FYM and SMC

● 1:1, v/v of decomposed FYM or SMC with composted coir pith

● Decomposed powdered bark of some forest trees

● Paper industry waste



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

● Burnt rice husk is also in use along with decomposed FYM (2:1, v/v) in seasonal cultivation of button mushroom in Hayrana and Punjab with reasonable success

**b. Quality of casing materials**

● Soft texture

● Light weight

● High water holding capacity

● High porosity

● Deficient in available form of C and N

● Neutral pH (7.0 – 7.5)

● Low conductivity (400-600 µ moh)

c. Casing treatment

Casing material should be treated properly before its application on the spawn run compost and the steps involved are:

● Make a heap of casing material

● Wet it up to 50-60% water holding capacity

● Fill in trays and shift them to pasteurization chamber

● Steam pasteurization at 60-65°C for 6-8 hours

● Auto-Cooling

**Alternatively,**

● Make a heap of casing material on a cemented platform

● Wet it up to 50-60% water holding capacity

● Drench the wet casing with formalin @ 1 litre/m3 (40% formaldehyde) by mixing with shovel

● Cover it with polythene sheet and seal the outer periphery thereafter by pouring sand/soil on outside margin

● Keep the material for 24-48 hours in sun for fumigation effect

● Remove the cover after 48 h and expose the material to open air and sunlight by spreading over with clean tools and permitting the formalin fumes to escape in to air for 2-3 days before it is used as casing (formalin treatment effect decreases at low temperature due to inadequate fumigation)

**d. Casing application**

● Unfold the fully spawn run bag and make the top surface even by gentle pressing with hands ● Light spray of water on spawn run compost

● Application of 4-5 cm thick layer of casing uniformly using iron rings of 4 cm height or wooden blocks ● Water sparay in installments immediately after casing application



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

Precautions

● Casing material should not be sieved but used as such with clumps, which permits more air spaces in casing

● Top casing surface should have small mounts and valleys

● Care should be taken to prevent re-infection of the casing materials

● Store casing material in a sterilized /clean room before use in polythene bags or synthetic cloth bags ● Apply water to casing in a few installments so that water does not run into spawn run compost

**e. Case run and pinhead formation**

Case run is done at a temperature of 24 ± 1°C, RH-95% and CO2 > 7500 ppm (strain dependent) for about one week. There is no requirement for fresh air introduction during case run. It is considered complete when mycelia come in the valleys of casing layer. After case run, the environmental conditions are changed by bringing down the temperature to 15-17°C (air), RH to 85% and CO2 to 800-1000 ppm (strain dependent) by opening of the fresh air ventilation and exhausting $CO_2$. This change in environmental parameters induces pinhead formation in 3-4 days (strain dependent) time. The pinheads develop into solid button sized mushrooms in another 3-4 days. At this stage, the air inside the cropping room is changed 4-6 times in an hour to maintain appropriate CO2 conc. as CO2 production is at its peak during first flush (actually peaks at case run).

**3. Supplementation**

Supplementation with protein rich supplements such as cotton seed meal, soybean meal, alfa-alfa meal, feather meal, etc. has been found to increase the mushroom yield.

Supplementation can either be done at spawning or after spawn run before casing. The later is more useful. Supplement is first grounded coarsely and denatured by treating with 5000 ppm formalin and before its mixing in compost. The practice normally increases the temperature of compost by 4-5°C and if done at the time of spawning or in poor quality compost, it results in killing of mushroom mycelium or increased incidence of moulds. If these problems are overcome supplementation can give 20-25% enhanced yield. Supplementation at casing in spawn run compost also helps in early and higher mushroom yield.

**4. Ruffling**

Ruffling of compost on completion of spawn run is done just before casing. This practice is particularly useful for round the year cropping when 5-6 crops are taken per year and cropping period is reduced to about 4 weeks, as this practice helps in exhaustion of compost earlier than



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

normal. Ruffling of casing after a 3-4 days or so after casing is done by some growers to get uniform pinning.

**5. Watering**

Mushroom contains nearly 90% water and that gives us an idea how water is important for the crop. Mycelium gets water from compost during spawn run and compost + casing during case run and from casing during fruit body formation. Water level in casing is maintained in 2 ways. One way is by its regular spray when pinheads are pea sized and then by maintaining RH at 80-85% during cropping. If one of the factors, (water spraying and RH) during cropping is disturbed, it will affect crop productivity. Low RH during cropping will result in drying of beds, lightweight mushrooms, discoloration of mushrooms and crop losses. Drying of casing will seal the casing medium resulting in mat formation, which becomes impervious to water, and results in tremendous crop losses. Water has to be replenished in casing to accommodate the water losses from casing due to mushroom growth and evaporation. Lesser the water loss to room air, better it is. Bed moisture and RH are although two different factors, but are interdependent. Water spraying on mushroom beds at pin breaks should be avoided. The casing should be wet enough when fresh air is brought in and room temperature lowered. The wetness should be sustained till pin heads become pea sized, and that is the stage when bed will require additional watering to allow pea-sized pins to develop into button sized mushrooms. Watering to beds requires monitoring at each stage. RH in the cropping room is monitored by using dry & wet bulb thermometers. Two ordinary stem thermometers are put in the cropping room, placing one in the casing/compost bed and one hanging in the air nearby (few cm apart). Bed temperature is 1-2°C higher than air temperature. Computer control of AHU ensures application of cropping parameters with precision during spawn run, case run and cropping. The water used for irrigation (spraying) on mushroom beds should be clean, neutral in pH and free from salts, heavy metals and other impurities. Water good enough for drinking/watering for vegetables/field crops is also good for mushroom cultivation. It is desirable to test the quality of water before the mushroom growing is started at a particular site.

**6. Harvesting and after care**

Mushrooms with 4-5 cm dia., with hard pileus and closed veil are ready for the harvest. Mushrooms are harvested by holding them between forefinger and thumb, and rotating in clockwise/anticlockwise direction. The soiled stem portion is cut with sharp edged knife and mushrooms are collected grade-wise in baskets. Dropping of the stem cuttings on the floor or the bed should be avoided, as these will promote the growth of undesirable microorganisms. Cleaning of mushroom beds and floor is recommended after each crop harvest. Fresh casing is applied at places



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

from where mushrooms have been removed. Water is sprayed at the rate the mushrooms have been harvested, i.e. for every kg of mushroom harvested 1 litre of water is added after harvesting. Damaged pins/ mushrooms, if any, are also to be removed from the bed manually. If bunching of mushrooms is observed, then there is a need to address the climate controls for creation of optimal environmental conditions during pinhead formation. Mushrooms after harvest are graded, packed in PP bags/card board boxes and preferably chilled at 4°C for 6-8 hours before sending to the market. The pre-market chilling enhances the shelf life of mushrooms. While harvesting care should be taken to keep the pileus free from casing soil, as it stains the mushrooms. Washing of mushrooms to make them extra white for increased acceptability in the market is undesirable, especially with Potassium metabisulphite solution. Unwashed mushrooms stay fresh for a longer period. Mushrooms should be handled carefully, and not bruised during the harvesting operation. Bruising will damage the mushroom tissue, which will turn the pileus dark/ pink on exposure to air. While packaging mushrooms in PP bag one should not forget to make a small hole (0.2 mm), as it will prevent the development of aflatoxins in transit or storage. Button mushroom can be stored at 4°C for a few days without any deterioration in its quality but it is desirable to consume/market fresh mushrooms. Since button mushroom has a very short shelf life and it cannot be stored for longer periods, hence it requires processing for long storage. Mushrooms are best preserved in brine solution after blanching, either in cans or jars. The properly processed mushrooms stay in good condition for over a period of 1 year. It is possible to transport canned mushrooms over longer distances without any deterioration in their quality. But fresh mushrooms can only be transported short distances in refrigerated vans/by air to reach up to a remunerative market.

**B. Environmental Crop Management**

Mushroom is an indoor crop, raised in cropping rooms with simulated environmental conditions suiting to a particular mushroom. Hence management of crop environment becomes utmost important. It includes the temperature, RH, CO2 concentration, air speed/ evaporation rate over crop beds, air changes in the room/oxygen availability and other such factors, which directly influence crop productivity. The environment management in the cropping room includes addressing of the following factors:

1. Temperature
2. Relative humidity (RH)
3. CO2 concentration

**1. Temperature**



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

Temperature in the room has two areas for monitoring i.e., air temperature and bed temperature. Temperature has direct bearing on crop productivity in synergy with other factors like RH and $CO_2$ /$O_2$ conc. in the cropping room. The bed temperature in the cropping room is directly influenced by the air temperature, so it is the air temperature that has to be addressed. The air temperature inside the room can be manipulated with use of cooling/heating coils in an Air Handling Unit (AHU) installed inside or outside the cropping room for climate control. An independent AHU is desirable for each cropping room. The AHU inside contains a set of cooling coils, heating coils, RH fogging jets and a centrifugal blower fan for blowing the conditioned air into the cropping room. The AHU is generally installed on top of the entry door and is joined with a recirculating duct from inside the cropping room. The cooling coils are fed with chilled water from the chiller, while the heating coils are fed with steam from boiler and fogging jets get water from trough placed at the bottom of the AHU by a small pump. The cooling requirement will depend upon compost quantity fed inside the room, outside prevailing temperature, insulation on the walls, etc. The blower fan blows the conditioned air into the room. The fresh air into the room goes in via AHU through a control valve, and during most of the crop raising period fresh air valve is placed at 20-30% and recirculating at 70-80%. During spawn run the entire air is recirculated (100%) and no fresh air entry is required.

**a. Spawn run**

For spawn run air temperature of 23 ± 1°C is maintained inside the cropping room, which corresponds to bed temperature of 24-25°C (1-2°C higher than air temperature). During this phase, the fresh air valve is closed and entire air is recirculated, allowing the carbon dioxide to accumulate to the level of 15000 ppm, desirable for quick spawn run. Higher concentration of $CO_2$ accelerates the spawn run/vegetative growth of the mushroom. Any increase or decrease in temperature effects the $CO_2$ production of the compost and the RH of the room. With increase in temperature, RH will tend to fall, and just vice versa with decrease in temperature. The properly insulated room will ensure uniform temperature inside the cropping room at every stage of crop growth. The heat from the cropping room is removed via cooling coils fitted inside the AHU.

**b. Case run**

The environmental conditions suitable for spawn run, are suitable for case run as well. The same conditions, as for spawn run will be continued for next 7 days for case run, i.e., temperature of 23 ± 1°C in the air and 24-25°C in the bed. The RH/$CO_2$ will also be same as for spawn run. Under aforesaid conditions the case run will be completed within one week, and at the same time the mycelium is observed in the casing valleys. Valleys are the areas between the peaks as can be seen



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

on top of casing. The $CO_2$ conc. and RH should also be maintained within the optimum range for quick and effective case run.

**c. Cropping**

After completion of case run, cooling inside the room is enhanced to bring the air temp. down to 15-17°C in the room within 2-3 days time. Simultaneously, the fresh air vent is opened to 30% and rest of the air is recirculated (70%). This brings down the $CO_2$ conc. inside the room to 800 to 1000 ppm, desired for pinhead formation. Likewise, the RH is also reduced to 85% from 95%. This facilitates pinhead formation on the casing within a week's time. The pinheads grow into full button sized mushrooms in another 3- 4 days. At this stage fresh air can be slightly reduced to achieve 1000-1500 ppm $CO_2$ concentration. The environment parameters are maintained as above during entire period of cropping. Since the temperature has influence on RH and $CO_2$ production from compost hence should be manipulated, keeping in mind its effect on other two factors. All the three parameters work in synergy with each other to induce pinning. The pinning will be affected adversely if any of these factors is not in its optimal range. High temperature for a long period of time during cropping will lead to sealing of casing, and will result in stopping of pinhead formation. The mycelium will continue growing in vegetative phase and will seal the casing, making it impervious to water, thus resulting in serious yield losses. The desired temperature in cropping room can be maintained with good precision by the use of sensors and controlling devices attached to cooling/heating coil inlets fitted inside the AHU. These devices are easily available and are effective in temperature control in the cropping room.

**2. Relative humidity**

Relative Humidity (RH) is the ratio/proportion between absolute humidity (AH) and saturation point of humidity (SPH) at a given temperature, expressed in percentage. Absolute humidity is number of grams of water vapours contained in a cubic meter of air at a given temperature. Saturation point of humidity is the maximum number of grams of water vapours feasible in a cubic meter of air at a given temperature. Relative humidity (RH) of 85% is necessary for obtaining highest pin head formation in synergy with other factors like temperature and $CO_2$ concentration. RH of 85% permits slow evaporation of water from the crop bed to air in the cropping room and thereby facilitating the upward movement of nutrients in the compost. This exchange of air facilitates loss of $CO_2$ + heat into the air, necessary for healthy pin head development and crop productivity. In the event of RH falling below 85% inside the cropping room, more moisture from the crop bed will be withdrawn resulting in drying of the casing layer. This will seal the casing and result in crop losses. Lower RH in the room will be indicated by bed temperature falling below the air temperature, an undesirable situation to



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

be avoided at any cost. Under normal circumstances the bed temperature is always higher by 1-2°C than air temperature for development of a healthy crop of mushrooms. For round the clock monitoring of RH, monitoring of the bed and air temperature inside the room is desirable. The incoming air should be humidified enough to prevent loss of moisture from the crop beds. Evaporation of moisture from crop beds has to be taken into consideration for calculating the g of water vapours required per m3 air in a room for maintaining the required RH for cropping. Air in a cropping room contains 9.6 g water vapours per m3 of air at 14°C (A), the saturation point of humidity at 14°C is 12 g/m3 (S). The RH of the room air will be A/S × 100=9.6/12 × 100 = 80%. The ultimate expression is the quantity of water vapours contained per m3 of the air space of the room at a given temperature. 31 g of water vapours gets evaporated from 1 m2 bed area at 17°C/85% RH/hour. The change in room temperature will alter the RH in the room. Use of RH sensors with cut off/starting devices for recording and maintenance of RH in a cropping room is very useful. The sensors will control the fogging jets in the AHU as per the requirement in the room. For obtaining a temperature of 17°C and RH of 85% in the cropping room, air temperature is brought down to 14°C at exit point of AHU with 100% RH. The air on reaching the crop bed will receive some heat from crop bed and raise the air temperature to 17°C with RH automatically falling to 85%.

**3. Carbon dioxide**

Carbon dioxide concentration is the third important factor in management of environment inside the cropping room. CO2 is produced by actively growing microorganisms in compost during spawn run, case run and by mushroom mycelia and mushrooms during entire cropping cycle. During spawn run, higher concentration of CO2 is desirable, which helps in quick and quality spawn run. For spawn run, CO2 concentration between 10000-15000 ppm is desirable (strain dependent) and it helps in quick spawn run in compost. Higher concentration of CO2 is also desirable during case run. For pinning and cropping, the CO2 concentration is lowered around ambient (800-1000 ppm). CO2 concentration upto 1500 ppm is maintained during pinning & cropping, and this is done by venting/opening of fresh air duct to bring in oxygen and exhaust of CO2 from exhaust vents under positive pressure. The opening of vent will bring in fresh air, which is conditioned in AHU (heated or cooled/humidified) and then blown into the cropping room via ducts. The CO2 gets mixed up with the fresh air and is carried under positive pressure towards the exhaust vent and finally exhausted. This also facilitates the exhaust of heat alongwith the CO2 from the room air. The heat is removed via cooling coils after the room air gets into the AHU via recirculating duct. During air circulation, recommended air speed over the crop beds is 15cm/sec. Ensure that the desired air movement is there in the central shelf in the middle row. This can be checked with the help of a burning incense stick, which will indicate the



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

direction of air movement in the cropping room. Higher concentration of $CO_2$ during pinning can seal the casing or produce onion shaped mushrooms with a bulbous base & a small cap. During development from pinhead to button sized mushroom, higher concentration of $CO_2$ will lead to long stiped mushrooms with a small cap (opened), which reduces the crop yields. By gentle movement of air over the crop beds, the $CO_2$ is carried away from the crop canopy, thus saving the bad effect of $CO_2$ trapped between the mushrooms in the crop canopy. To ensure healthy crop production, about 6 air changes per hour are recommended from the venting time to completion of first 2 flushes. During this period, $CO_2$ production is highest (10 g/h/m2) and it requires to be removed at a faster rate. Along with $CO_2$, heat is also produced @ 10W per hour from one m2 bed area at 17°C and 88% RH. In subsequent flushes, 4 air changes per hour are sufficient to maintain right $O_2$ content in the cropping room (about 16%). During first two flushes fresh air vent is opened to 30% entry and 70% recirculation, and in subsequent flushes the fresh air vent is put at 20% and recirculation at 80%. Use 2 µm mesh filters on fresh air entry points into the cropping room to restrict the entry of diseases/competitor mould spores. The $CO_2$ after mixing with the room air, gets exhausted under positive pressure from exhaust vents, thereby helping in heat + $CO_2$ removal from the room. Maintenance of right combination of casing moisture (about 50 ± 2%), $CO_2$ concentration, RH and temperature at pinning stage of crop growth helps in obtaining a heavy pin set, thus resulting in a luxurious crop growth and excellent yield of mushrooms. If onion sized mushrooms/drum sticks are observed, correct air circulation for effective $CO_2$ removal from crop beds is required. Lack of air movement and accumulation of $CO_2$ creates this type of situation. Long stemmed mushrooms are again the outcome of $CO_2$ accumulation in the air around crop canopy due to faulty air movement/air circulation inside the cropping room.

**C. Airing Procedure for Fruiting**

Venting or opening of fresh air for induction of fruiting after case run is a critical phase in mushroom growing. Whether to cool first or bring in fresh air first is a question bothering commercial mushroom growers. The airing is done suiting a particular situation, whether one wants to have a heavy first flush followed by moderate flushes later or equally spaced flushes. The airing accordingly is handled under 3 heads:

1. Soft airing
2. Moderate airing
3. Severe airing

**1. Soft airing**



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

Soft airing means that we will have severe restriction on venting to get smaller flushes suiting to market demand and the air is opened slowly. The growing parameters to be manipulated for soft airing are listed below:

| | |
|---|---|
| Air temperature: | 19°C in 48 hours 17°C in 72 hours |
| Compost temperature: | 21°C in 96 hours |
| CO2 concentration: | 4000 ppm in 48 hours 2000 ppm next 24 hours 1000 ppm after 72 hours |
| RH: | 98% to 92% in 48 hours |

**2. Moderate airing**

Moderate airing means that we will have some restriction on airing/venting to get well spaced flushes of moderate levels. The growing parameters to be manipulated for moderate airing are listed as under:

| | |
|---|---|
| Air temperature: | 17°C in 24 hours 20°C in 72 hours |
| Compost temperature: | 20°C in 72 hours |
| CO2 concentration: | 2000-2500 ppm in 24 hours Less than 1000 ppm in 48 hours |
| RH: | 98% to 92% in 24 hours |

**3. Severe airing**

Severe airing is done to obtain a heavy first flush and no restriction is put on airing. This results in heavy pin set and large first flush, followed by smaller subsequent flushes. The growing parameters to be manipulated for severe airing are listed below:

| | |
|---|---|
| Air temperature: | 15°C as soon as possible |
| Compost temperature: | 20°C in 48 hours |
| CO2 concentration: | Less than 1000 ppm in 12 hours |
| RH: | 98% to 90% in 12 hours |

**Further Readings**


1. Arkenbout, J. 1988. Air conditioning as a technical procedure. In The Cultivation of Mushrooms (ed: LDLJ Van Griensven): 145-177.

2. Arkenbout, J. 1988. Air treatment in mushroom growing. In The Cultivation of Mushrooms (ed: LDLJ Van Griensven): 179-212

3. Dhar, B.L. 1994. Farm Design for white button mushroom cultivation. NCMRT Technical Bulletin No. 6, pp 26.

4. Dhar, B.L. 2002. Infrastructure for seasonal and round the year cultivation of white button mushroom. In Recent Advances in the Cultivation Technology of Edible Mushrooms (ed. RN Verma and B. Vijay): 71-94.




**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com

5. Hermans, C. 1988. Climate and Cultivation technique. In The Cultivation of Mushrooms (ed. L.D.L.J. Van Griensven): 213-248.

6. Vedder, P.J.C. 1978. Some physical phenomenon. In Modern Mushroom Growing: 36-5



**Dr Rajesh Kumar Pandey,** Assistant Professor, Department of Botany, Bundelkhand University, Jhansi-284128, Uttar Pradesh, Email: rkp_vam@rediffmail.com