International Journal of Current Science Research
www.drbgrpublications.in

IP Indexing - Impact factor – 3.5
Volume: 3; Issue: 10; October-2017; pp 1395-1401. ISSN: 2454-5422

Conversion of agricultural by products: Mushroom Cultivation

Binit Kumar[1*], Chanchila Kumar[2], Manish Kumar[3]and V K Singh[4]

[1]SRF- NICRA KVK, Koderma, ICAR-NRRI-CRURRS, Jharkahnd, India.
[2]In-charge KVK, Koderma, ICAR-NRRI-CRURRS, Jharkahnd, India.
[3]Technical officer KVK, Koderma, ICAR-NRRI-CRURRS, Jharkahnd, India.
[4]Senior Scientist, IISR, Lucknow, Uttar Pradesh, India.
[*]Corresponding author email: binitplantpatho@gmail.com

Abstract

An experiment was conducted to evaluate the effect of different casing mixture on various parameters such as number of days required for mycelium run and pin head initiation on casing layer, weight of fresh harvested mushroom per bag, number of fruiting per bag, biological efficiency (%) and cost benefit ratio of white button mushroom [*Agaricus bisporus* (Lange) Imbach]. In the mushroom crop room three treatments including control with eight replications were taken up. Treatments comprised of T_0 Garden loam soil (GLS) + Farm yard manures (FYM) (2:1), T_1 GLS + FYM + Vermicompost (VC) (2:1:1), T_2 GLS + FYM + slack lime (2:1:1). During cultivation colonization of the casing soil with mushroom mycelium and initiation of pin head stage (17-25 days), total number of fruiting bodies (83.25), maximum yield (0.94kg/bag), biological efficiency (18.21) and cost benefit ratio 1:2.08 were recorded in GLS + FYM + Vermicompost (2:1:1) as compared to control and other combinations.

Keywords: *Agaricus bisporus*, casing, vermicompost, yield.

Introduction

Mushroom is the fruiting body of the fungus, which is neither an animal nor a plant. Mushrooms are saprophytes. These have been a food supplement in various cultures and they are cultivated and eaten for their edibility and delicacy. They fall between the best vegetables and animal protein source. These are considered as source of protein, vitamins,

fat, carbohydrates, amino acids and minerals. All essential amino acids are present as well as water-soluble vitamins. These are good sources of vitamins like riboflavin, biotin and thiamine, indicated that mushroom is about 16.5% dry matter out of which 7.4% is crude fiber, 14.6% is crude protein and 4.48% is fat and oil. Protein contents vary between 24 to 44% in *Agaricus* sp. The protein value of mushrooms is twice as that of asparagus and potatoes, four times as that of tomatoes and carrots, and six times as that of oranges. Their energy value also varies according to species, which is about equal to that of an apple (Adejumo and Awosanya, 2005).

Compost for the production of white button mushroom (*A. bisporus*) is prepared from wheat straw, straw-bedded horse manure, chicken manure and gypsum. It is prepared from a mixture of organic materials subjected to a composting process for making it selective for growth of *A. bisporus.* The preparation of mushroom compost has for many years been divided into distinct phases, phase I during which raw material are mixed, wetted and stacked with considerable dry matter losses, and phase II, which includes pasteurization and conditioning treatment to produce a selective and pathogen free substrate, due to scarcity of horse manure, many efforts have been made by researchers to develop its alternative materials named as "synthetic compost". Synthetic compost formulations remained standard for several years and scientist have recommended various formulations from different parts of the world depending upon the availability of Agro wastes (Yigitbasi *et al*., 2006). In India, first National Research Centre for Mushroom was established by Indian Council of Agriculture Research at Chambaghat, Solan (HP).

Casing soil plays an important role in the cultivation of *A. bisporus.* Although many different materials may adequately function as a casing layer (3-5cm), peat is generally used and recommended as a good casing medium. The main function of casing layer is the production of quantity and quality mushrooms. Casing layer, which is nutritionally deficient medium brings about important morphological changes from transition of vegetative growth to fruiting stage. Casing is generally done to make a surface where uniform fruitification can take place and to provide anchorage and essential reserves for developing sporophores of mushrooms (Shandilya, 2002).

The annual world productions of all types of mushrooms are estimated to be over 25 million tones. Our country produces only 0.12 million tones mushroom, out of which button mushroom contributes about 85% of the total mushroom production of country. Even if 1% of the available

agricultural residues are utilized for mushroom production, the country can produce over 3 million tons of mushrooms and 10 million tons of organic manure annually. Mushroom cultivation mainly depends on the agriculture crop residues. These crop resides are abundantly available in our country. It is primarily used as cattle feed and remaining part is burnt or spread in the field. Agro-wastes contain about 80% cellulose, hemi-cellulose, and lignin which are not easily degradable, but most of the edible fungi posses enzyme system which degrade these components. Thus, mushroom cultivation can avoid environmental pollution by recycling agricultural wastes and can convert straw into easily digestible animal feed.

Materials and Methods

The experiment was conducted in the Mushroom Crop Room of KVK, Koderma. The experimental site is situated besides bank of Barakar River at Block road on a distance of 20 km form Koderma city. Geographically this is located at 24^0 22' 0" N and 85^0 39' 0" E longitude at an Altitude of 397 meters above the sea level Jainagar (Koderma) is located in typical sub-tropical climatic zone, which experiences extremely hot summer and cold winter, especially during December and January. In winter season temperature falls as low as 8-10^0C while during the summer months it reaches as high as 40-45^0C.

Compost is the substrate on which mushroom grows. The biochemical activity of a number of microorganisms makes the substrate selective for the growth of *A. bisporus.* It is defined as indefinite microbial degradation of organic waste. During composting, distinct changes occur in the physical, chemical and biological characteristics of the straw, all of which influence the productivity of *A. bisporus* subsequently. Compost was prepared by long method which took approximately 28-30 days. The compost was prepared on clean concrete floor, on the roof of KVK, Jainagar (Koderma). The concrete floor was sterilized with 2% formalin solution. Wheat straw was gently spread on the concrete floor up to height a of 6-9 inches and sprinkling of water was done until each particle of wheat straw became wet, with sprinkling of water wheat straw was continuously turned with the help of iron forks. After wetting process, wheat straw was left for 72 hours, the ingredients except gypsum and insecticide were mixed thoroughly, and water was sprinkled. Piling of substrate was done for 28 days and total eight turning was gave to compost each turning gave at four days interval. After eighth turning, pile was opened with the help of wooden stick. The compost was looked dark brown in color, without any smell of

ammonia and sufficient moisture content (68-70%) when pressed between palms. This was last turning of pile, after this period compost was ready for spawning. Attributes of good compost is color should be Dark brown, Sweet fragrance and Moisture contain 70%.

Table 1.1: Component used for Compost preparation

Ingredients	Quantity	Ingredients	Quantity
Wheat straw	300 kg	Fungicide	150 g
Wheat bran	15 kg	Nitrogen	0.43 %
SSP	3 kg	Phosphorus	0.17 %
MOP	3 kg	Ash	0.19 %
Urea	6 kg	Water holding capacity	100 %
Gypsum	35 kg	Insecticide	150 g

Spawn are propagating seeds of mushroom. This is used for cultivation of mushroom. A pure culture of the mycelium grown on a special medium (Cereal), which is the mushroom seed is comparable to the vegetative seed in crop plants. Spawning was done in each mushroom bag. It was filled with 7kg of compost and 7.5gm of spawn. After spawning, mushroom bags were kept in mushroom crop room and appropriate temperature, relative humidity and hygienic condition were maintained. Temperature (20-24^{0}C) was maintained during winter season by room heater, and humidity (80-90%) was maintained by sprinkling of water on the floor of crop room (twice or thrice daily).

Fig 1: Mycelium of *A.bisporus*

Fig 2 & 3: Fruiting bodies of *A.bisporus* on casing mixture.

After complete mycelium run on the compost, white patches of mycelium were observed on the compost surface and it emitted a sweet fragrance in the crop room. An ideal casing

material has certain characteristics of good water holding capacity, enough aeration, alkaline in reaction and free from moulds, insects and undecomposed vegetable matter. The casing materials were sterilized with 2% formalin and mixed in different ratio for top dressing of compost bag. Thickness of casing layer was maintained at 3cm (Amin *et al*., 2010). During the experiment following casing materials were used in certain combinations-

T_0	Control (Garden loam soil + Farm yard manures) (2:1) water spray
T_1	Garden loam soil (GLS) + Farm Yard Manures (FYM) + Vermicompost (VC) (2:1:1)
T_2	Garden loam soil (GLS) + Farm Yard Manures (FYM) + slake lime (2:1:1)

Results and Discussion

During the cultivation process observations were recorded at the different stages of crop growth on various parameters such as number of days required for mycelium run and pin head initiation on casing layer, weight of fresh harvested mushroom per bag, number of fruiting per bag, biological efficiency (%) and cost benefit ratio was calculated. The probable reason for minimum days required for mycelium of *A. bisporus* run in casing layer, appearance of pin head stage, maximum number of fruiting bodies, biological efficiency and cost benefit ratio in treatment combination of vermicompost with FYM may be that bulk density, porosity, aeration, water holding capacity, pH value and electric conductivity of casing material. Similar findings were reported by Singh *et al.* (2000), Choudhary *et al.* (2008) and Amin *et al.* (2010).

Table 1.2 Effect of different casing materials on number of days required for mycelium run and initiation of pin head on casing layer

S. No.	Treatment combinations	AD	FW	NFB	BE	B:C
T_0	Control (Garden loam soil + Farm yard manures) (2:1) water spray	25.00	0.30	14.50	5.86	1:1.62
T_1	Garden loam soil (GLS) + Farm Yard Manures (FYM) + Vermicompost (VC) (2:1:1)	**17.62**	**0.94**	**83.25**	**18.21**	**1:2.08**
T_2	Garden loam soil (GLS) + Farm Yard Manures (FYM) + slake lime (2:1:1)	22.25	0.61	45.87	11.87	1:2.07

AD: Avg Days, FW: Fresh Weight, NFB: Number of Fruiting body per bag, BE: Biological efficiency, B:C: Cost Benefit ratio.

The yield of *A. bisporus* may have been the physio-chemical properties and thickness of casing layer favored the early and frequent pin head initiation resulting maximum fruiting bodies. The

maximum biological efficiency (%) of *A. bisporus* probably depend on casing mixture quality the physical properties, aeration and presence of organic content in casing material provided in suitable condition to up take maximum amount of nutrition from the compost and casing materials The other treatment combination were dense, had imbalanced nutrition and high amount of carbon-dioxide content, which may have favoured for growth of various competitive moulds on casing layer. The findings related with the articles of Pandey (2004), Dhar *et al*. (2006) and Laxmipathy *et al*. (2011). The probable reason for such findings may have the C/N ratio, availability of micro and macro nutrients and physical properties of casing material may have provided suitable condition for growth and development of fruiting bodies, which may have leads to gave highest profit in comparison to other treatment combination.

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