

Mushroom - A Compost Bio-fertilizer

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Introduction

Mushroom cultivation is a beneficial, cost-effective and flourishing pursuit in recent times especially when the pandemic strike the Indian fruit and vegetable market. Mushroom agripreneurs has evolved finding best opportunities with less initial investment. But one problem faced by the mushroom cultivators with less land holding is the safe disposal of leftover residue. Improper and careless dumping of this residue creates environmental problem and groundwater contamination. Spent is the mushroom spawn residue or the compost after full crop of mushroom and the further production of the same become worthless. But this waste material is a 'hidden gem' which is a nutrient rich bio-fertilizer source.

Bio-fertilizer

Bio-fertilizer contains living microorganisms that can colonizes the rhizosphere, and improves the soil physical and biological factors or the microbes colonizes in the interior of the plant and enhance growth by increasing the availability of basic nutrients like nitrogen, phosphorus etc. to the host plant and thus exhibiting a symbiotic relationship. Different types of bio-fertilizers including Nitrogen fixing bio-fertilizer, Phosphorus mobilizing bio-fertilizer, Plant Growth Promoting Rhizobacteria (PGPRs) and Compost biofertilizer. In compost bio-

fertilizers waste materials are decomposed using microorganisms like fungi, bacteria, actinomycetes, algae, and soil friendly fauna like earthworms convert waste to best bio-fertilizers. Being a fungus belonging to Phylum *Basidiomycota*, mushroom opens its economical importance in being a plant growth promoter apart from other medical and nutritional properties. Among the other wide range value added products from mushroom, spent mushroom substrate can be an effective bio-fertilizer. This can be a substitute for chemical fertilizer and improves soil structure and enhance plant growth by secreting hormones.

***Pleurotus* Spp. -The Compost Mushroom**

Mushroom belonging to the genus *Pleurotus* have the capacity to degrade part of cellulose and lignin present in plant biomass. Upon utilizing this property of *Pleurotus* it is used as an agent for degradation in coir pith composting. The mushroom releases enzymes such as cellulases and lactases, bringing down the C: N ratio as well as lignin content. The coir pith is converted into good manner after two months and the lignin content is reduced from 30% to 40%. Also the C: N ratio changes from 112:1 to 24:1 reduce the volume by 40%. For treating 1tonne of coir pith, 1.5 kg mushroom is required. It also add essential nutrients like nitrogen, phosphorus, calcium in the compost. *Pleurotus spp.* directly in the plant growth medium can also stabilize C: N ratio, improves soil degradation and nutrient enrichment. *Pleurotus sajor caju* is an edible mushroom, producing cellulolytic enzyme that secrete free enzymes depend on the hydrolysis of lignocelluloses into usable sugars. It can improve soil physical properties by decreasing the bulk density, increasing aggregate stability, reduces surface crust formation, increasing infiltration rate, aeration and water retaining capacity of the soil.



Fig:-1 *Pleurotus sajor caju*

Spent Mushroom Substrate (SMS) As A Bio-fertilizer

Spent (used) mushroom substrate of edible mushroom like paddy straw mushroom, oyster mushroom, button mushroom can help in plant growth as a bio-fertilizer. Fresh SMS contains 1.9-0.4-2.4% (N-P-K), while 8-16 months old contains 1.9-0.6-1.0 (N.P.K)^[1]. SMS is a good nutrient source for agriculture. Its application in soil improves soil texture, water holding capacity and nutrient status. Incorporation of SMS adds basic primary nutrients i.e. Nitrogen, Phosphorus and Potassium where other bio-fertilizers are nutrient specific which support utilization of any particular nutrient only. The microbes growing over the spent mushroom exert antagonism to soil pathogens thus protect the plants from soil-borne diseases. Other recomposing treatment improves the quality of SMS and thereby increasing its efficiency to be used as an organic fertilizer for vegetables and horticultural crops. This facilitates the growth of plants, increases yield and plant biomass. SMS adsorbs the organic and inorganic pollutants and biodegrades them into non-toxic forms thus helps in reclamation of chemically contaminated soils. Mushrooms belonging to the genus *Pleurotus* can degrade biomass and stabilize C:N ratio by releasing enzymes that break down cellulose and lignin. SMS of paddy straw mushroom (*Volvariella volvacea*), oyster mushroom (*Pleurotus ostreatus*) and button mushrooms (*Agaricus bisporus*) can be used as feeding material for vermicomposting. Composting using spent mushroom results in highly enriched bio-fertilizer containing microbes in cow dung, earthworm and mushroom substrate, thus killing two birds with a single stone.



Fig:-2 Mushroom beds after harvesting full crop

Vermi-composting of Spent Mushroom Substrate

The paddy straw bed after complete harvesting, the left behind is integrated along with cow dung and kept as a feed for earthworm. The commonly used earthworm species

suitable with the paddy straw are *Eudrillus spp.*, *Perionyx sp.* and *Eisenia spp.* Initial layer of spent mushroom of 5 to 10 cm height and small lumps of fresh or dry cattle dung over the straw, over this matter worms allowed to feed. The time of composting varies with the number of earthworm used. About 4 to 5 kg of waste can be composed by 1000 worms. Maintenance of moisture and frequent turn covering is essential. After 40 to 50 days spent mushroom substrate become powdered mass and ready for application in plants. Also vermiwash, a brown colored liquid fertilizer is collected from the compost.

Table:-1 showing nutrient comparison using different feeding material (cow dung and cow dung + spent mushroom substrate) for vermi-composting.

Sl. No	Nutrients	Cow dung (%)	Cow dung + SMS (%)
1	Nitrogen	0.3	2.02
2	Phosphorus	0.6	0.21
3	Potassium	0.28	0.45
4	Organic Carbon	47.3	18.9
5	C:N	47.1	9.35

Source: Recycling of spent mushroom substrate to vermicompost by Pushpa S.Murthy, H.K.Manonmani

Other Uses of Spent Mushroom Substrate

- It can act as a soil amendment, using as mulch for soil improvement.
- Helps in reclamation of the soil and thereby improving the soil texture of water holding capacity and nutrient status of the soil.
- Disease Management through antagonistic action of the fungi present in the substrate, process the growth of nematodes like *Meloidogyne incognitia*.
- Helps in bioremediation by chemical absorption of organic and inorganic pollutants.
- Re-growing of Mushrooms on the SMS after supplemented with proper nutrients.
- SMS from edible mushroom like oyster mushroom can be used as animal feed also.

Conclusion

Mushroom cultivation is less investment, lucrative enterprise where plant waste or crop residues like paddy straw is used as raw material, aids the production of medical and invigorating edible mushrooms but the waste material from this enterprise is the crux of the



matter. By identifying the positives and potentialities of the substrate as a bio-fertilizer and nutrient substitute the 'Waste can be converted to Best'.

