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Research Article

Integrated management of green mold (*Trichoderma* sp.) in Dhingri mushroom *(Pleurotus sajor-caju)* using botanicals, biocontrol agents and fungicides

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ABSTRACT: Integrated management strategies for green mold (*Trichoderma* sp.) were evaluated under mushroom house conditions. The treatments included *Azadirachta indica*, *Bacillus subtilis*-II, and Carbendazim, which were applied individually and in combination. The combination of Carbendazim + *B. subtilis*-II + *A. indica*, as well as *B. subtilis*-II alone, demonstrated the shortest spawn run duration (14.8 days). The longest spawn run period was observed in the treatment combining *B. subtilis*-II and *A. indica* (16.6 days), though this was still shorter than the control (17.8 days). Regarding pinhead formation, the minimum time (5.6 days) was recorded in the treatments with Carbendazim + *B. subtilis*-II + *A. indica* and Carbendazim + *B. subtilis*-II. The highest yield increase (27.9%) over the control was achieved with the combined application of Carbendazim + *B. subtilis*-II + *A. indica*. Other treatments also improved yield, including Carbendazim + *A. indica* (25.9%), Carbendazim + *B. subtilis*-II (25.1%), Carbendazim alone (23.7%), *B. subtilis*-II + *A. indica* (22.4%), and both *B. subtilis*-II and *A. indica* individually (19.0%). Importantly, no incidence of green mold was observed in the treatments using either Carbendazim + *B. subtilis*-II + *A. indica* or Carbendazim alone, indicating complete suppression of the pathogen. Minimal disease incidence (5.7%) occurred in the Carbendazim + *B. subtilis*-II, Carbendazim + *A. indica*, and *B. subtilis*-II treatments.

KEYWORDS: Green mold, integrated management, mushroom, yield

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INTRODUCTION

Dhinghri (*Pleurotus* spp.) mushrooms are considered to be healthy due to their abundance in fibre, vitamins, minerals, and proteins (Feeney *et al.*, 2014). *Pleurotus* mushrooms have a pleasant flavour and aroma, as well as nutritional and therapeutic benefits, which make them a useful meal. *Pleurotus* species, or oyster mushrooms, are cultivated commercially around the world (Knop, 2015). The basidiocarps of oyster mushrooms have an oyster or shell shape pileus and come in a variety of colours, including white, cream, grey, yellow, pink, or light brown (Singh & Singh, 2011). About 40 species make up the genus *Pleurotus*, which is found throughout a large spectrum of tropical and temperate regions (Golak-Siwulska *et al.*, 2018). Different types of lignocellulosic wastes have reportedly been used to cultivate 26 species, including *Pleurotus eryngii, Pleurotus citrinopileatus, Pleurotus flabellatus, Pleurotus ostreatus, Pleurotus djamor var. roseus*, and *Pleurotus florida* (Singh & Singh, 2011; Bano & Srivastava, 1962; Mandeel, 2005; Islam, 2009; Bernardi, 2013; Bumanlag, 2018; Suguimoto, 2001). Numerous *Pleurotus* species were discovered and cultivated commercially.

Pleurotus species are grown on a large scale utilising a variety of agro-wastes following inexpensive production methods (Jegadeesh *et al.*, 2018). An estimated 998 million tons of agricultural waste, such as cereal, wheat, and paddy straw, are produced worldwide. Because *Pleurotus* mushrooms grow on these agricultural wastes, their production contributes to waste recycling and alleviates the nutritional gap that mostly affects people in China, India, and Africa. The spent substrates from mushroom houses are also utilised to produce biogas, fertiliser, and animal feed (Kakon *et al.*, 2012).

Pleurotus mushrooms are becoming more and more popular because of their high protein and dietary fibre content (Singh & Singh, 2011;) as well as their necessary and non-essential amino acids—lysine and leucine in particular. *Pleurotus* species are thought to provide an alternate source of meat, fish, and vegetables due to their high mineral content (Kakon *et al.*, 2012; Ahmed *et al.*, 2016). Despite being widely cultivated, *Pleurotus ostreatus* is less in demand globally than shiitake (*Lentinula edodes*) and button (*Agaricus bisporus*) mushrooms (Indian Council of Agricultural Research, 2019; Wakchaure, 2011). This is because of their shorter

shelf life. However, they can be dried, and hence can have additional value, making them potential competitors on the international market (Wakchaure, 2011). Many researchers have extensively investigated the nutritional benefits and therapeutic potential of *Pleurotus* species (Khatun, 2015; Khan & Tania, 2012). Mevinolin, Nicotinic acid, and a higher concentration of β-glucan compounds found in *Pleurotus* species have been successfully demonstrated to be a food supplement that lowers blood cholesterol levels in individuals with heart disease (Raman *et al.*, 2014).

Intensive cultivations of *Pleurotus* sps. are commonly susceptible to certain bacterial, fungal, and viral diseases, which frequently result in a sharp decline in their production. In recent years, severe symptoms of green mold have been observed in oyster mushroom farms, resulting in huge crop losses.

Green mold on *P. ostreatus* was first documented to have appeared in North America (Sharma & Vijay, 1996). After that, serious cases of this disease in *P. ostreatus* produced commercially were found in Hungary (Hatvani *et al.*, 2007), Romania (Kredics *et al.*, 2006), South Korea (Park, 2004), and most recently, Spain (Gea, 2009). The two *Trichoderma* species, which are genetically closely related but are phenotypically very distinct —*Trichoderma pleurotum* and *Trichoderma pleuroticola*—were described as the causal agents of Green mold disease in *Pleurotus* cultivation (Komon-Zelazowska *et al.*, 2007). These pathogens cause serious crop losses in the mushroom industry.

Different approaches are being used to prevent or control mushroom diseases. Mushroom growers mostly rely on fungicides and pesticides for controlling mushroom diseases and pests, but due to their ill effects, alternatives, biological control is more preferred than chemicals due to their lethal effects during the consumption of mushrooms.

The present investigation aimed at management of green mold disease in *Pleurotus* cultivation by following an integrated management strategy, by identifying locally available and cost-effective botanicals and bacterial biocontrol agents, under the temperate climatic conditions of the Kashmir Valley.

MATERIALS AND METHODS

In this study, botanical, bacterial antagonists, and fungitoxicants (*in vitro* studies) were evaluated *in vivo* together in different combinations for the development of an integrated management strategy.

The selected botanical, bioagent, and fungicide, which displayed maximum efficacy against the pathogen in the previous *in vitro* experiments and *in vivo* trials, were *A. indica* (Neem), *Bacillus subtilis-II,* and Carbendazim. All these treatments were evaluated *in vivo* in a cultivation trial of *Pleurotus sajor-caju*. The following combinations were made to develop an integrated management strategy:

(i) Fungitoxicants (F)
(ii) Biocontrol agent (BA)
(iii) Botanical (BO)
(iv) F x BA
(v) F x BO
(vi) BA x BO
(vii) F x BA x BO
(viii) Control (untreated straw)

A single trial was laid out for carrying out this study. During this investigation, the bag method of cultivation was adopted. 42 poly bags with 10-15 holes were used, and the same cultivation practice was adopted. Each bag was filled with paddy straw at the rate of 1 kg dry substrate per bag. The spawn of *P. sajor-caju* was added to the substrate at the rate of 1% per bag, in layers.

In 1st treatment, Carbendazim at the promising concentration was evaluated against the pathogen inoculated with the paddy straw. Paddy straw bits, after being rinsed twice, were drenched in carbendazim solution at the rate of 0.1 % for 5 h. The straw was drained properly and then filled with poly bags. The spawn of *P. sajor-caju* was added to the straw layer wise.

In 2nd treatment, the efficacy of *B. subtilis-II* was checked *in vivo*. The lignite powder containing *B. subtillis-II* inoculants was added to paddy straw at the rate of 3% (w/w) on a dry weight basis just before spawning. This straw amended with the bacterial inoculants was then filled in bags, and the spawn was inoculated layer-wise.

In 3rd treatment, the best botanical, *i.e.*, *A. indica,* was evaluated *in vivo*. Drained paddy straw was mixed with dried powder of Neem leaves at the rate of 3% (w/w). Straw amended with the neem powder was filled in bags, and spawn was added to it layer-wise.

The 4th treatment was the combination of Carbendazim and *B. subtillis-II*. The straw was soaked in 0.1% of carbendazim for 5 h. After that substrate was drained properly. Lignite powder containing *B. subtillis-II* inoculants was incorporated in the paddy straw by mixing, at the rate of 3% on a dry weight basis sowing before spawning. The straw was then filled in bags, and the spawn was added to it.

In the 5th treatment, a combination of Carbendazim and *A. indica* was evaluated *in vivo*. The straw was soaked in a

0.1% aqueous solution of carbendazim for 5 h. The straw was then drained properly. Dried powder of neem at the rate of 3% was incorporated in the substrate before filling in bags. Spawn at the rate of 1% was added layer-wise.

In the next treatment, a combination of *B. subtillis-II* and *A. indica* (Neem) was tested *in vivo.* In this study, paddy straw was washed and then drained properly. Dried powder of *A. indica* and lignite with *B. subtillis-II* inoculant was added to the straw at the rate of 3% on a dry weight basis. The straw amended with the neem leaf powder and *B. subtilis-II i*noculants was then filled into poly bags. Spawn was added to it layer-wise.

In the last treatment, a combination of Carbendazim, *B. subtillis-II* and *A. indica* was evaluated *in vivo*. Firstly, paddy straw was drenched in a 0.1% aqueous solution of carbendazim for 5 hours. The straw was drained and then mixed with fine powder of neem and lignite containing *B. subtillis-II* inoculants at the rate of 3%. This treated straw, along with spawn (1%), was filled in bags. All the treatments, including the check (untreated), were replicated six times in CRBD. The bags were transferred to the cropping room, where temperature (30°C max. and 26°C min.) and relative humidity of 80% were maintained. The cropping room, having spawned bags, was kept in the dark for 10-15 days till complete colonisation of the substrate with mushroom mycelium. All the treated bags, including control (untreated), were inoculated with 3ml spore suspension of *Trichoderma harzianum* at the rate of 1 x 10^3 spores/ml.

After complete colonisation, the temperature was dropped to 15-17°C and the relative humidity was increased to 90-95%. The cropping room was aerated with the help of an exhaust fan for 3-4 h. Three mushroom flushes were picked for one month.

The observations on days for spawn-run, first pin formation, per cent (%) increase in yield over control and per cent (%) disease incidence were recorded.

Per cent increase in yield in treated bags over control (untreated) was calculated using the formula:

$$\text{Percent increase in Yield over control} = \frac{\text{Yield treatment} - \text{Yield control}}{\text{Yield treatment}} \times 100$$

Statistical analysis

The experiment was carried out in a Completely Randomised Design (CRD) with 7 treatments including fungicide, bacterial biocontrol agents, botanicals, and their combinations, with each treatment replicated thrice. The data obtained from *in vivo* studies were subjected to Analysis of Variance (ANOVA). The Critical Difference (CD) was used to compare treatment means.

RESULTS AND DISCUSSION

Time taken for complete colonisation/Spawn-run

It is clear from Table 1 that all the treatments alone and in different combinations, at all concentrations, more or less, reduced the time taken for complete colonisation by mycelium of *Pleurotus sajor-caju* as compared to the control. In this *in vivo* trial, the minimum number of days (14.8 days) for the spawn run in *P. sajor-caju* was shown by the treatments inoculated with *Bacillus subtilis*-II alone at 3% and a combination of (Carbendazim + *Bacillus subtilis*-II + *A. indica*) at (0.1+3+3%). It was followed by treatment, showing the combination of (Carbendazim + *B. subtilis*-II) (15.0 days) at the concentration of (0.1+3.0%), *A. indica* alone (15.1 days) at the concentration of 3.0%, (Carbendazim + *A. indica*) (15.3 days) at the concentration of (0.1+3.0%), Carbendazim (16.1 days) at 0.1% concentration. Maximum time for spawn run (16.6 days) was shown by the treatment (*B. subtilis*-II + *A. indica*) at (3+3%) concentration. The average number of days for the spawn-run recorded in the control was 17.8 days, respectively.

Days taken for pin head formation

It is evident from Table 2 that all the treatments were more or less effective in reducing the time taken for pin head formation by *P. sajor-caju.* A minimum time (5.6 days) was taken by treatments (Carbendazim + *B. subtilis*-II + *A. indica*) and (Carbendazim + *B. subtilis*-II), followed by *B. subtilis*-II alone (5.8 days), (Carbendazim + *A. indica*) (6.0 days), (*B. subtilis*-II + *A. indica*) (6.1 days), *A. indica* alone (6.3 days). Maximum time for pin formation (6.5 days) was observed in the treatment of Carbendazim alone. The average number of days for pin formation recorded in the control was 7.8 days, respectively.

Per cent increase in yield over control

It is clear from Table 3 that all the treatments, more or less, enhance the yield of *P. sajor-caju* when compared to the control. Maximum increase in yield (27.9%) over control was recorded in treatment, showing the combination of (Carbendazim + *B. subtilis*-II + *A. indica*) (Plate 16), followed by treatment (Carbendazim + *A. indica*) (25.9%), (Carbendazim + *B. subtilis*-II) (25.1%), Carbendazim alone (23.7%), (*B. subtilis*-II + *A. indica*) (22.4%), (19.9%) by *A. indica* alone and (19.0%) by *B. subtilis*-II alone (Plate 1).

Per cent disease incidence

It is evident from Table 4 that all the treatments were effective in reducing the disease incidence of *Trichoderma harzianum* when compared to the control, devoid of any

treatment. The disease incidence of *T. harzianum* was not observed in the treatments, (Carbendazim + *B. subtilis*-II + *A. indica*) and Carbendazim alone. The treatments that exhibited the minimum disease incidence (5.7%) were recorded in (Carbendazim + *B. subtilis*-II), (Carbendazim + *A. indica*) and *B. subtilis*-II alone. It was followed by (*B. subtilis*-II + *A. indica*) (11.2%). Maximum disease incidence (22.2%) was recorded in the treatment of *A. indica* alone. The disease incidence recorded in the control was 83.3%.

The integrated management approach, combining various treatments, has been evaluated for its impact on the cultivation of *Pleurotus sajor-caju*. The presented data outlines key parameters such as time taken for complete colonisation, days required for pin head formation, the percentage increase in yield over control, and disease incidence. These findings provide valuable insights into the efficacy of the integrated management strategy.

The study reveals a significant reduction in the time taken for complete colonisation by *P. sajor-caju* when subjected to various treatments. Notably, treatments involving *Bacillus subtilis-II* alone at 3% and a combination of (Carbendazim + *B. subtilis-II* + *A. indica*) at (0.1+3+3%) exhibited the minimum days required for the spawn run. This emphasises the positive influence of these treatments on mycelium colonisation efficiency.

The data indicate that all treatments contributed to a decrease in the time required for pin head formation, a critical stage in mushroom cultivation. Combinations like (Carbendazim + *B. subtilis-II* + *A. indica*) and (Carbendazim + *B. subtilis-II*) demonstrated the shortest time for pin head formation, further highlighting the potential synergies in integrated management.

Several bacterial species, *viz*., *Pseudomonas* spp., *Bacillus* spp., and Actinomycetes, were previously tested for their antifungal activity against *Trichoderma* sp. and showed potential mycelial growth inhibition of *T. harzianum* to a much greater extent and stimulated defence mechanisms through the production of enzymes such as laccases (Liu *et al.*, 2015).

The study demonstrates a promising increase in yield for *P. sajor-caju* under various treatments compared to the control. The combination of (Carbendazim + *B. subtilis-II* + *A. indica*) exhibited the maximum increase in yield (27.9%), suggesting a positive additive effect of the combined treatments on mushroom production. Several authors reported that some bioactive components of *A. indica, Eucalyptus*

Table 1. Influence of Integrated management on time taken for complete colonisation by mycelium of *Pleurotus sajor-caju*

Treatment	Conc (%)	* Spawn-run (No. of Days)
Carbendazim	0.1	16.1
Bacillus subtilis-II	3.0	14.8
Azadiracta indica	3.0	15.1
Carb + *Az. indica*	0.1+3.0	15.3
Carb + *B. subtilis*-II	0.1+3.0	15.0
B. subtilis-II + *Az. indica*	3.0+3.0	16.6
[Carb + *B. subtilis*-II + *Az. Indica*]	0.1+3.0+3.0	14.8
Control	-	17.8

*Mean of six replications.

Carb = Carbendazim; *Az. indica* = *A. indica*; *B. subtilis*-II = *Bacillus subtilis*-II

Table 2. Influence of Integrated management on time taken for pin formation by the mycelium of *Pleurotus sajor-caju*

Carbendazim	0.1	6.5
Bacillus subtilis-II	3.0	5.8
Azadiracta indica	3.0	6.3
Carb + *Az. indica*	0.1+3.0	6.0
Carb + *B. subtilis*-II	0.1+3.0	5.6
B. subtilis-II + *Az. indica*	3.0+3.0	6.1
[Carb + *B .subtilis*-II + *Az. Indica*]	0.1+3.0+3.0	5.6
Control	-	7.8

*Mean of six replications

Carb = Carbendazim; *Az. indica* = *A. indica*; *B. subtilis*-II = *Bacillus subtilis*-II

Table 3. Influence of Integrated management on the yield of *Pleurotus sajor-caju* during a month cropping period.

Treatment	Conc. (%)	* Yield (gms) during one month		% increase in yield over control
		Control value	Treatment	
Carbendazim	0.1	823.3	1080	23.7
Bacillus subtilis-II	3.0	-	1016.6	19.0
Azadiracta indica	3.0	-	1028.3	19.9
Carb + *Az. ind*	0.1 + 3.0	-	1111.6	25.9
Carb + *B. sub*-II	0.1 + 3.0	-	1100.0	25.1
B. sub-II + *Az. ind*	3.0 + 3.0	-	1061.6	22.4
Carb + *B. sub*-II + *Az. ind*	0.1 + 3.0 + 3.0	-	1143.3	27.9
S. Em± = 15.09			C.D @ 0.05% = 25.20	

* Mean of 3 flushes.

Carb = Carbendazim; *Az. ind* = *Azadiracta indica*; *B. sub*-II = *Bacillus subtilis*-II

Table 4. Influence of Integrated management on disease incidence of *Trichoderma harzianum* in *Pleurotus sajor-caju* cultivation

Treatment	Conc (%)	Disease incidence (%)
Carbendazim	0.1	0.25 (2.8)*
Bacillus subtilis-II	3.0	5.7 (13.8)
Azadiracta indica	3.0	22.2 (28.1)
Carb + *Az. indica*	0.1+3.0	5.7 (13.8)
Carb + *B. subtilis*-II	0.1+3.0	5.7 (13.8)
B. subtilis-II + *Az. indica*	3.0+3.0	11.2 (19.5)
Carb + *B. subtilis*-II +	0.1+3.0+3.0	0.25 (2.8)
Az. indica		
Control		83.3 (65.8)

* Figures in parentheses are transformed angular values
Carb = Carbendazim; *Az. indica* = *A. indica*; *B. subtilis*-II = *Bacillus subtilis*-II

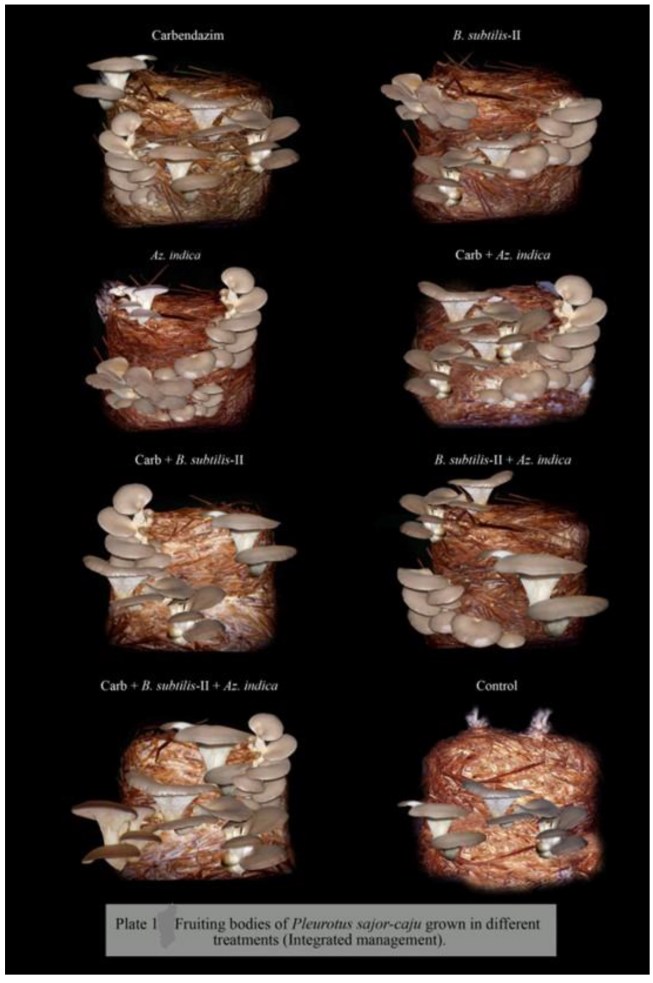


Plate 1 Fruiting bodies of *Pleurotus sajor-caju* grown in different treatments (Integrated management).

camaldulensis, Cymbopogon marginatus, and Citrus lemon are capable of enhancing the potential yield of mushrooms and slowing down the progression of pathogenic microbes in oyster mushroom cultivation (Inam-ul-Haq *et al.*, 2010).

Stanojevi'c *et al.* (2019) reported that bacterial isolates were highly effective against the mycelial growth of *T. aggressivum f. europaeum*, indicating their potential use as an effective biocontrol agent for the management of mold diseases. Under *in vivo* conditions, the application of bacterial antagonist isolates in pathogen-infested casing material showed significant and stimulating effects on mushroom yield and yield components, viz., the weight and number of fruit bodies. The integrated management approach proved effective in reducing the incidence of *T. harzianum*, a common contaminant in mushroom cultivation. Certain treatments, such as (Carbendazim + *B. subtilis-II + A. indica*) and Carbendazim alone, completely prevented disease incidence. This highlights the potential role of these treatments in enhancing the resistance of *P. sajor-caju* against harmful pathogens. The antifungal activity of plant extracts against the mold pathogens may be ascribed to antifungal volatile and nonvolatile metabolites such as azadirachtin, nimbidin, nimbinin, nimbolidin, and nimbin, from *A. indica,* which are responsible for damaging the fungal cell walls (Chakraborty *et al.*, 2013). *A. indica* was the most effective botanical and showed maximum inhibition against *T. harzianum* without inhibiting the mushroom mycelium (Kumar, 2017).

CONCLUSION

In conclusion, the integrated management strategy employed in this study has demonstrated positive effects on various parameters that are crucial for successful *P. sajor-caju* cultivation. The findings underscore the potential of combining biological agents like *Bacillus subtilis-II* and *A. indica* with chemical treatments like Carbendazim to enhance yield and mitigate disease incidence. Further research and field trials may be warranted to validate and optimise these integrated approaches for broader application in mushroom cultivation.

REFERENCES

Ahmed, M., Abdullah, N., and Nuruddin, N. N. 2016. Yield and nutritional composition of oyster mushrooms: An alternative nutritional source for rural people. *Sains Malays*, **45**(11): 1609-1615.

Bano, Z., and Srivastava, H. C. 1962. Studies on the cultivation of *Pleurotus* sp. on paddy straw. *Food Sci*, **11**: 363-365.

Bernardi, E., Minotto, E., and Nascimento, J. S. 2013. Evaluation of growth and production of *Pleurotus* sp. in sterilized substrates. *Arq Inst. Biol*, **80**(3), 318-324. https://doi.org/10.1590/S1808-16572013000300009

Bumanlag, C. P. B., Kalaw, S. P., and Dulay, R. M. R. 2018. Optimum conditions for mycelia growth and basidiocarp production of *Pleurotus djamor* on corn based media. *Int J Biol Pharm Allied Sci*, **7**(4): 558-575. https://doi.org/10.31032/IJBPAS/2018/7.4.4423

Chakraborty, M. R., Ojha, S., Medda, R. N., and Chatterjee, N. C. 2013. An integrated approach towards *in vivo* control of mushroom weeds vis-à-vis yield. *J Agric Sci Technol*, **15**: 819-828.

Feeney, M. J., Dwyer, J., and Hasler-Lewis, C. M. 2014. Mushrooms and health summit proceedings. *J Nutr*, **144**(7): 1128S-1136S. https://doi.org/10.3945/jn.114.190728 PMid:24812070 PMCid:PMC4056650

Gea, F. J. 2009. First report of *Trichoderma pleurotum* on oyster mushroom crops in Spain. *J Plant Pathol*, **91**: 504.

Golak-Siwulska, I., Kaluzewicz, A., and Spizewski, T. 2018. Bioactive compounds and medicinal properties of Oyster mushrooms (*Pleurotus* sp). *Folia Hortic*, **30**(2): 191-201. https://doi.org/10.2478/fhort-2018-0012

Hatvani, L., Antal, Z., Manczinger, L., Szekeres, A., Druzhinina, I. S., Kubicek, C. P., …, Kredics, L. 2007. Green mold diseases of agaricus and *Pleurotus* spp. are caused by related but phylogenetically different trichoderma species. *Phytopathology*, **97**(4), 532-537. https://doi.org/10.1094/PHYTO-97-4-0532 PMid:18943294

Indian Council of Agricultural Research. 2019. Mushroom market size and industry analysis, by type (button mushroom, shiitake mushroom, oyster mushroom, and others), form (fresh mushroom, frozen mushroom, dried mushroom, and canned mushroom), and regional forecast 2019- 2026. Indian Council of Agricultural Research, Chambaghat.

Inam-ul-Haq, M., Khan, N. A., Khan, A., and Khan, M. S. 2010. Use of medicinal plants in different composts for the yield improvement of various strains of oyster mushroom. *Pak J Bot*, **42**: 3275-3283.

Islam, M. Z., Rahman, M. H., and Hafiz, F. 2009. Cultivation of oyster mushroom (*Pleurotus flabellatus*) on different substrates. *Int J Sustain Crop Prod*, **4**(1): 45-48.

Jegadeesh, R., Lakshmanan, H., and Kab-Yeul, J. 2018. Cultivation of pink oyster mushroom *Pleurotus djamor* var. roseus on various agro-residues by low-cost technique. *J Mycopathol Res*, **56**(3): 213-220.

Kakon, A. J., Choudhury, B. K. M., and Shusmita, S. 2012. Mushroom is an ideal food supplement. *J Dhaka Natl Med Coll Hosp*, **18**(1): 58-62. https://doi.org/10.3329/jdnmch.v18i1.12243

Khan, M. A., and Tania, M. 2012. Nutritional and medicinal importance of *Pleurotus* mushroom: An overview. *Food Rev Int*, **28**(3): 313-329. https://doi.org/10.1080/87559129.2011.637267

Khatun, S., Islam, A., and Cakilcioglu, U. 2015. Nutritional qualities and antioxidant activity of three edible oyster mushrooms (*Pleurotus* spp.). *NJAS-Wagen J Life Sci*, **72-73**:1-5. https://doi.org/10.1016/j.njas.2012.03.003

Knop, D., Yarden, O., and Hadar, Y. 2015. The ligninolytic peroxidases in the genus *Pleurotus*: divergence in activities, expression, and potential applications. *Appl Microbiol Biotechnol*, **99**(3): 1025-1038. https://doi.org/10.1007/s00253-014-6256-8 PMid:25503316

Komoń-Zelazowska, M., Bissett, J., Zafari, D., Hatvani, L., Manczinger, L., Woo, S., …, Druzhinina, I. S. 2007. Genetically closely related but phenotypically divergent trichoderma species cause green mold disease in oyster mushroom farms worldwide. *Appl Environ Microbio*, **73**: 7415-7426. https://doi.org/10.1128/AEM.01059-07 PMid:17827333 PMCid:PMC2168202

Kredics, L., Timea, C., Hatvani, L., and Körmöczi, P. 2006. Green mould disease of oyster mushroom in Hungary and Transylvania. *Acta Microbiol Immunol Hung*, **53**: 306-307.

Kumar, K., Kumar, M., Singh, J. K., Goyal, S. P., and Singh, S. 2017. Management of the green mould of milky mushroom (*Calocybe indica*) by fungicides and botanicals. *Int J Curr Microbiol Appl Sci*, **6**: 4931-4936. https://doi.org/10.20546/ijcmas.2017.610.465

Liu, C., Sheng, J., Chen, L., Zheng, Y., Yue, D., Yang, Y., Xu, M., and Shen, L. 2015. Biocontrol activity of *Bacillus subtilis* isolated from *Agaricus bisporus* mushroom compost against pathogenic fungi. *J Agric Food Chem*, **63**: 6009-6018. https://doi.org/10.1021/acs.jafc.5b02218 PMid:26050784

Mandeel, Q. A., Al-Laith, A. A., and Mohamed, S. A. 2005. Cultivation of oyster mushrooms (*Pleurotus* spp.) on various lignocellulosic wastes. *World J Microbiol Biotechnol*, **21**(4): 601-607. https://doi.org/10.1007/s11274-004-3494-4

Park, M. S., Bae, K. S., and Yu, S. H. 2004. Molecular and morphological analysis of Trichoderma isolates associated with the green mold epidemic of oyster mushroom in Korea. *J Huazhong Agric Univ*, **23**: 157-164.

Raman, J., Nanjian, R., and Lakshmanan, H. 2014. Hypolipidemic effect of *Pleurotus djamor* var. roseus in experimentally induced hypercholesterolemic rats. *Res J Pharm Biol Chem Sci*, **5**(2): 581-588.

Sharma, S. R., and Vijay, B. 1996. Yield loss in *Pleurotus ostreatus* spp. caused by Trichoderma viride. *Mushroom Res*, **5**: 19-22.

Singh, M. P., and Singh, V. K. 2011. Yield performance and nutritional analysis of Pleurotus citrinopileatus on different agro-wastes and vegetable wastes. 7th Int Conf Mushroom Biol Mushroom Prod, Arcachon, France.

Stanojević, O., Berić, T., Potočnik, I., Rekanović, E., Slaviša Stanković, and Milijašević-Marčić, S. 2019. Biological control of green mould and dry bubble diseases of cultivated mushroom (*Agaricus bisporus* L.) by *Bacillus* spp. *Crop Prot*, **126**: 104944. https://doi.org/10.1016/j.cropro.2019.104944

Suguimoto, H. H., Barbosa, A. M., and Dekker, R. F. 2001. Veratryl alcohol stimulates fruiting body formation in the oyster mushroom, *Pleurotus ostreatus*. *FEMS Microbiol Lett*. **194**(2): 235-238. https://doi.org/10.1111/j.1574-6968.2001.tb09475.x PMid:11164314

Wakchaure, G. C. 2011. Mushrooms value added products. In: Singh M, Vijay B, Kamal S and Wakchaure GC, editors. Mushrooms cultivation, marketing and consumption. Solan (India): Directorate of Mushroom Research (p. 235-238).