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Suppression of Plant Diseases by Exploiting Spent Mushroom Substrate

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Abstract

The substrate released following mushroom crop harvest, more often referred to as "SMS", is also of critical importance. It is an organically rich substrategenerated in vast quantities, around five times that of fresh mushrooms has the capacity to complement the nutritional needs of agricultural plants while also safeguarding them from various insect pests and diseases due to its physical, chemical, and microbiological qualities, if handled appropriately. It has the ability to bio-remediate soils that have been damaged with pesticides and heavy metals in excess. In this sense, it has the ability to defend plants in a multifaceted manner, with its nutritional richness supporting plant development while chemical contents and microbial components simultaneously activate the plant defence system or exhibit antagonism. The SMS's recycling backend provides an environmentally friendly option for growing high-quality crops as well as a long-term waste management solution, resulting in a comprehensive contribution to agriculture's long-term progress.

Introduction

The fruiting body of a macrofungal, the mushroom, is an essential food item because of its high nutritional and potential therapeutic benefits. Mushroom cultivation is an environmentally benign activity since it uses waste from agricultural, poultry, breweries, and other industries to produce fruit bodies with outstanding and unique nutritional and therapeutic properties.

The substrate released following mushroom crop harvest, more often referred to as "SMS," is also of critical importance. Recomposed SMS has been found to be a good growth medium for the significant number of vegetables and field crops. After multiple cycles of mushroom manufacturing, spent mushroom substrate (SMS) is produced, which is a by-product of the mushroom business. Between 1978 and 2013, the worldwide production of cultivated & edible mushrooms increased by nearly 34-fold (Zepeda-Bastida *et al.*, 2016). In 1978, it was around one million tonnes, and in 2013, it was expected to be 34.8 million tonnes.

Spent Mushroom Substrate for Disease Management

SMS has been proven to be a useful nutrition source for agriculture due to its nutrient status, high cation exchange capacity, and slow mineralization rate, which allows it to preserve its quality as organic matter. During mushroom vegetative growth as well as fruiting, the growing mycelium excretes a variety of compounds, including organic matter, bioactive compounds, and lignocellulose degrading enzymes, which can contribute to SMS becoming an effective bio-agent against soilborne pathogens that cause plant diseases (Ahlawat *et al.*, 2022).

Mushrooms are strong in nutrients, but some types also have therapeutic properties such as polysaccharides and antimicrobial compounds with strong antibacterial activity. Extracts of different mushrooms, including *Lentinula edodes* as well as, *Pleurotus ostreatus*, & *Hypsizigus tessullatus*, have been found to have antibacterial action in vitro against pathogenic microorganisms (Ahlawat *et al.*, 2022).

Several soil-borne diseases, including *Fusarium oxysporum f. sp. lycopersici* in tomato, *F. oxysporum f. sp. dianthi* in carnation, *Pythium aphanidermatum*, *Rhizoctonia solani* and *Botrytis cinerea* in cucumber, are inhibited by spent mushroom compost (Ahlawat *et al.*, 2022).

The use of SMS from button mushrooms in conjunction with bioagents (*Trichoderma viride* and *Pseudomonas fluorescens*) @ 5 g kg^{-1} SMS aids in the management of damping off disease of tomato caused by *Pythium aphanidermatum*, and it is highly effective in disease containment as pre-emergence and post-emergence appearance (Ahlawat *et al.*, 2022).

Trochoderma spp. identified from SMS, including *Trichoderma viride* and *T. harzianum*, shown considerable antagonism against the *Rhizoctonia solani* causative agent of damping off and root rot diseases in tomato in screen house and nursery conditions (Ahlawat *et al.*, 2022). *T. harzianum*, however, is more effective against disease-causing fungus than *T. viride*, and in controlled in vitro trials it demonstrated 33.48 percent and 72.29 percent stronger inhibition of disease-causing fungal growth over control at 3 and 4 days after inoculation, respectively (Ahlawat *et al.*, 2022).

The addition of 2.0 percent mushroom compost to potting soil reduces Fusarium wilt disease index (67-74%), disease incidence (44-96%), and mortality in tomato plants (Ahlawat *et al.*, 2022).

SMS has been found to contribute to the growth of entomopathogenic fungi, by extending their persistence and increasing their efficiency. *Beauveria bassiana* (Balsamo) displays its efficacy in controlling the black vine weevil (*Otiorhynchus sulcatus* F.) larvae when the growth media is amended with SMS (a 75±7% reduction in live larvae), upon compared to growth medium without SMS.

It's becoming more common to hear about plants being treated with SMSs to prevent plant diseases as shown in the Table 1 (Fujita *et al.*, 2021; Ahlawat *et al.*, 2022). To explain these suppressive effects, two alternative mechanisms have been proposed. The first process involves infections being directly inhibited by the antibacterial properties of the chemicals found in SMSs. The second mechanism is the induction of defense responses in plants (Fujita *et al.*, 2021), which includes the build-up of PR gene transcripts CaBPR1, as well as CaPR-4, & CaPR-10, rise in salicylic acid (SA) levels,

Table 1: Reports on the usage of discarded mushroom substrate for plant disease management (Ahlawat *et al*., 2022)

Host plant	Diseases	Casual organism	SMS types	Mechanism of action or active component
Tomato	Root knot	*Meloidogyne*	*Oyster mushroom*	SMS
Tomato	Damping off	*Pythium aphanidermatum*	*Agaricus bisporus*	*Trichoderma viride* + *Pseudomonas fluorescens* + SMS
Tomato	Root rot	*Phytophthora capsici*	*Agaricus bisporus*	Aerated spent compost tea
Tomato	Fusarium	*Fusarium oxysporum* f. sp. *lycopersici* (Fol)	*Oyster mushroom*	Autoclaved and non- autoclaved water extract of SMS
Potato	Potato early dying disease	*Verticillium dhlia* and/or *Pratylenchus penetrans*	*Agaricus bisporus*	SMS amendment
Garden pea	Fusarium wilt and powdery mildew	*Fusarium solani* f. sp. *pisi* and *Erysiphe pisi*	*Agaricus bisporus*	Anaerobically recomposted SMS
cucumber	Anthracnose	*Colletotrichum orbiculare*	*Lyophyllum decastes Sing*	Autoclaved water extract of SMS and autoclaved SMS (Systemic acquired resistance)
cucumber	Fusarim wilt	*Fusarium oxysporum* f. sp. *cucumerinum*	*Flammulina velutipes*	SMS
Button mushroom	Dry bubble	*Lecanicillium fungicola*	*Agaricus bisporus*	Leached SMS and extract
Chick pea	Wilt	*Fusarium oxysporum* f. sp. *ciceri*	*Agaricus bisporus*	Bio-agent + SMS
Chick pea	Collar rot	*Sclerotium rolfsii*	*Agaricus bisporus*	SMS at different proportion
Rice	Rice blast	*Pyricularia oryzae*	*Lentinula edodes*	Phenolic acids from edodes SMS

all of which have been linked to the induction of systemic acquired resistance (SAR) by SMS treatment (Fujita *et al.*, 2021).

The use of *L. edodes* SMS as compost reduced the degree of anthracnose in cucumber plants. Spraying water extract of *Lyophyllum decastes* SMS on rice blast fungal lesions prevented the growth of lesions, as a result they induced défense responses such as phytoalexin accumulation and pathogenesis related (PR) genestranscriptions, that encode proteins produced in response to pathogen infection and are indicators of defense response activation.

Conclusion

The wise and sustainable utilisation of natural resources, such as water, fertilisers, and organic resources, is critical to agriculture's future success. Each resource has its own weighting based on its availability and quality. In the case of mushroom production, the main raw materials (base ingredients) are all of agricultural origin, and they all drain nutrients from the soil, which necessitates their recycling in due course. According to a review of the literature, a significant amount of research has been done in this area, but it has primarily focused on vegetables and a few selected fruits and field crops.

As a result, a future focus might be on characterising the chemical elements of SMS from various mushrooms and their potential application in inducing systemic acquired resistance to diseases and insect pests in crops that have not yet been covered. A possible topic of research is the molecular mechanisms or signalling involved in SMS-mediated SAR induction against illnesses. With their complex role in agriculture and business, SMSs can also serve as a source of novel microorganisms.

References

Ahlawat, O.P., Kumar, S., Sharma, P., 2022. Spent mushroom substrates (SMS) - a potential source of bio-agents for plant diseases management. In: *Compendium of Mushroom Diseases*. Edition 1st, Chapter: 12. Indian Phytopathological Society, Division of Plant Pathology, IARI, New Delhi, pp. 108-124.

Fujita, R., Yokono, M., Ube, N., Okuda, Y., Ushijima, S., Fukushima-Sakuno, E., Ueno, K., Osaki-Oka, K., Ishihara, A., 2021. Suppression of *Alternaria brassicicola* infection by volatile compounds from spent mushroom substrates. *Journal of Bioscience and Bioengineering* 132(1), 25-32.

Zepeda-Bastida, A., Ojeda-Ramírez, D., Soto-Simental, S., Rivero-Perez, N., Ayala-Martínez, M., 2016. Comparison of antibacterial activity of the spent substrate of *Pleurotus ostreatus* and *Lentinula edodes*. *Journal of Agricultural Science* 8(4), 43. DOI: https://doi.org/10.5539/jas.v8n4p43.