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Evaluation of Enriched Mushroom (*Hypsizygous ulmaris*) Spent Substrate as a Nursery Mixture for Growth of Tomato Seedlings

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Hypsizygous ulmaris **spent paddy straw and coir pith was enriched with beneficial microorganisms such as *Azatobacter chroococcum, Bacillus megaterium* and *Trichoderma harzianum* individually and as consortia. *H. ulmaris* spent coir pith with consortia of beneficial microorganisms along with sand and soil found to be better nursery mix compared to individual inoculation of beneficial microorganisms for growth of tomato seedlings. Among the spent mushroom substrate spent mushroom coir pith supported the better growth and showed good dehydrogenase activity compare to spent mushroom paddy straw.**

Key words: Spent mushroom substrates, *Hypsizygous ulmaris,* paddy straw, Coir pith, *Azatobacter chroococcum, Bacillus megaterium* and *Trichoderma harzianum*.

Mushrooms are fruiting bodies of fungi belonging to Basidiomycetes and Ascomycetes Mushroom cultivation is a good bioconversion process for the utilization of a wide range of residues from the agro-industrial sector. Oyster mushroom mainly cultivated on Paddy straw, Ragi straw, wheat straw, Maize stalks, Coir pith, etc. After mushroom cultivation the productivity of the substrate decreases, after that mushroom cultivation becomes unremunerative and the residual by-product is known as spent mushroom substrate (SMS). SMS earlier considered as waste, now found many uses in organic farming.

The SMS after proper decomposition / suitable treatment has been used for cultivation of fruits, vegetables, flowers and foliage crops (Lohrvi and Coffey, 1987), and it also has a plant disease suppressive quality, rendering it a unique multifunctional constituent of a potting mix (Peter and Edmond, 2001). The SMS release nutrients slowly. Furthermore, SMS contain micronutrients that are usually not present in standard NPK fertilizers. They are also sources of enzymes and usually have a great diversity of microorganisms. In this context present study was conducted to evaluate the enriched *Hypsizygous ulmaris* spent substrate as a nursery mixture for growth of tomato seedlings

MATERIALS AND METHODS

Production of SMS

Hypsizygous ulmaris mushroom was grown on paddy straw and coir pith by using bag method, after the harvest of mushroom the left out paddy straw and coir pith was used as SMS for further studies.

Multiplication of beneficial microorganisms

The pure cultures of beneficial microorganisms like *Azotobacter chroococcum, Bacillus megaterium* and *Trichoderma harzianum* were obtained from the Department of Agricultural

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Microbiology, UAS, GKVK, Bangalore and were mass multiplied in Waksman No. 77, Pikovoskaya's and potato dextrose broths respectively.

Green house experiments

A green house experiment was conducted to evaluate the effect of enriched *Hypsizygous ulmaris* spent substrate as potting mixture for growth of tomato seedlings using Adithi tomato variety in the Department of Agricultural Microbiology, GKVK Campus, University of Agricultural Sciences, Bangalore.

Effect of microbialy enriched spent mushroom substrate on tomato nursery

In this experiment *H. ulmaris* spent paddy straw and coir pith were enriched with *A. chroococcum, B. megaterium* and *T. harzianum,* this enriched SMS was mixed with sand and soil at 1:1:1 ratio and filled in to the seedlings trays containing 28 cones of 25 cc size at the rate of 7g/ cone. Sand: Soil: FYM was used as a control treatment. Seeds were sown in each cone then seedlings were raised. Twenty five days after sowing seedlings were harvested from seedling trays and the roots were washed with water to remove soil particles and organic debris. Root length and shoot length of seedlings were recorded, fresh weight of shoot and root was recorded. Dry weight of plant samples, including shoot and root were recorded after drying to a constant weight in an oven at 60°C.

The dehydrogenase activity in the rhizosphere soil was determined by the procedure as given by Casida *et al.* (1964). For this, one gram of potting mixture were thoroughly mixed with 0.2 g of $CaCO_3$ and three replicate samples of soil were placed in three test tubes for each treatments saperately. To each sample one milliliters of 3% 2, 3, 5-triphenyl tetrazolium chloride (TTC) and 2.5 ml of distilled water were added. Samples were then incubated at 37^{O} C for 24 h. Afterwards, 10ml of methanol was added to each tube. Then the suspensions were filtered through filter paper. The filtrate was diluted with methanol to 100 ml volume and the intensity of reddish color was measured at 546 nm using a spectrophotometer.

Statistical analysis

The data collected in this study was subjected to completely randomized statistical analysis for drawing conclusions (Littly and Hills, 1978).

RESULT AND DISCUSSION

Influence of enriched mushroom (*Hypsizygous ulmaris*) spent paddy straw on tomato nursery

Influence of enriched *Hypsizygous ulmaris* spent paddy straw (*Hg SPS*) on tomato nursery was observed at 25 days after sowing (DAS) and presented in Table 1. The shoot length of seedlings ranged from 8.38 cm to 10.53 cm. Maximum shoot length was observed in the treatment Sand: Soil: *Hypsizygous ulmaris* spent paddy straw (S: So: *Hg* SPS) with consortia of beneficial microorganisms (10.53 cm) followed by S: So: *Hg* SPS: *B. megaterium* (9.96 cm). These were followed by S: So: *Hg* SPS: *T. harzianum* (9.41 cm). The minimum seedling height was recorded in the treatment S: So: *Hg* SPS (8.38 cm). The root length of tomato seedlings was also recorded on 25 DAS. Treatments differed significantly with respect to root length. Maximum root length was observed in the treatment S: So: *Hg* SPS: consortia (16.53 cm), followed by the treatment S: So: *Hg* SPS: *T. harzianum* (14.5 cm). The lowest root length was recorded in the treatment S: So: FYM (11.3 cm). The results of the present investigation are in conformation with the findings of Dayananda, (2008).

Tomato seedlings were harvested at 25 DAS, shoot fresh and dry weight of 10 seedlings was recorded. Maximum fresh and dry weight of shoot was recorded in S: So *Hg* SPS: consortia (9.97 g and 1.61 g respectively), Minimum fresh and dry weight of tomato shoot was recorded in the nursery mix S: So: *Hg* SPS (8.22 g and 0.96 g respectively) the results are in accordance with Mallesha, (2008).

Maximum fresh and dry weight of root was recorded in S:So: *Hg* SPS: consortia (7.83 and 1.08g respectively) and was on par with S:So: *Hg* SPS: *B. megaterium* (7.65 and 0.89 g respectively), S:So: *Hg* SPS: *T. harzianum* (6.96 and 0.76 g respectively), nursery mix. Minimum fresh and dry weight of tomato roots was recorded in the nursery mix containing S: So: FYM (4.4 and 0.44 g respectively).

At 25 DAS maximum dehydrogenase activity was recorded in S: So: *Hg* SPS: consortia (0.579) which is on par with S:So: *Hg* SPS: *T. harzianum* (0.56) and S:So: *Hg* SPS: *A. chroococcum* (0.543). Minimum dehydrogenase

Table 1. Influence of enriched *Hypsizygous ulmaris* spent paddy straw on tomato seedlings

S. No	Treatments	Seedling height (cm) 25 DAS		Biomass (g / 10 Seedlings)				Dehydrogenase activity (Absorbance at 546 nm)
		Shoot length	Root length	Fresh weight of shoot	Dry weight of shoot	Fresh weight of root	Dry weight of root	
1	S:So:FYM	9.76 ^{c}	11.3 ^{f}	9.29 ^{b}	1.02 ^{c}	4.4 ^{b}	0.44 ^{e}	0.07 ^{d}
2	S:So: *Hg* SPs	8.38 ^{e}	12.4 ^{e}	8.22 ^{e}	0.96 ^{c}	6.53 ^{a}	0.98 ^{ab}	0.174 ^{c}
3	S:So: *Hg* SPs: *A.c*	9.33 ^{d}	13.1 ^{d}	8.83 ^{d}	1.07 ^{c}	6.53 ^{a}	0.66 ^{d}	0.543 ^{a}
4	S:So: *Hg* SPs: *T.h*	9.41 ^{d}	14.5 ^{b}	9.06 ^{c}	1.28 ^{b}	6.96 ^{a}	0.76 ^{cd}	0.56 ^{a}
5	S:So: *Hg* SPs: *B.m*	9.96 ^{b}	13.9 ^{c}	9.1 ^{c}	1.40 ^{b}	7.65 ^{a}	0.89 ^{bc}	0.427 ^{b}
6	S:So: *Hg* SPs: *Consortia*	10.53 ^{a}	16.53 ^{a}	9.97 ^{a}	1.61 ^{a}	7.83 ^{a}	1.08 ^{a}	0.579 ^{a}

Note : Mean values in each column with same superscript (s) do not differ significantly by DMRT (P = 0.05)

S: Sand
So: Soil
FYM: Farm Yard Manure
Hg SPS: *Hypsizygous ulmaris* spent paddy straw

T. h : Trichoderma harzianum
A.c: Azatobacter chroococcum
B.m: Bacillus megaterium
Consortia : *A. chroococcum*, *T. harzianum*, *B. megaterium*

Table 2. Influence of enriched Hypsizygous ulmaris spent coir pith on tomato seedlings

S. No	Treatments	Seedling height (cm) 25 DAS		Biomass (g / 10 Seedlings)				Dehydrogenase activity (Absorbance at 546 nm)
		Shoot length	Root length	Fresh weight of shoot	Dry weight of shoot	Fresh weight of root	Dry weight of root	
1	S:So:FYM	9.76 ^{e}	7.3 ^{f}	9.29 ^{c}	1.02 ^{e}	4.4 ^{f}	0.44 ^{d}	0.07 ^{d}
2	S:So: *Hg* SCP	10.42 ^{d}	9.4 ^{e}	12.10 ^{bc}	1.41 ^{d}	6.44 ^{e}	0.94 ^{c}	0.2193 ^{b}
3	S:So: *Hg* SCP: *A.c*	11.93 ^{c}	10.04 ^{d}	13.1 ^{abc}	1.55 ^{c}	6.91 ^{d}	1.07 ^{bc}	0.18 ^{c}
4	S:So: *Hg* SCP: *T.h*	13.6 ^{b}	11.32 ^{b}	15.56 ^{ab}	1.66 ^{b}	7.56 ^{b}	1.29 ^{a}	0.274 ^{a}
5	S:So: *Hg* SCP: *B.m*	11.96 ^{c}	10.9 ^{c}	14.9 ^{ab}	1.59 ^{c}	7.09 ^{c}	1.12 ^{b}	0.2133 ^{b}
6	S:So: *Hg* SCP: *Consortia*	14.1 ^{a}	11.97 ^{a}	17.15 ^{a}	1.94 ^{a}	8.02 ^{a}	1.34 ^{a}	0.224 ^{a}

Note : Mean values in each column with same superscript (s) do not differ significantly by DMRT (P = 0.05)

S: Sand

So: Soil

FYM: Farm Yard Manure

Hg SPS: *Hypsizygous ulmaris* spent paddy straw

T. h : Trichoderma harzianum

A.c: Azatobacter chroococcum

B.m: Bacillus megaterium

Consortia : *A. chroococcum, T. harzianum, B. megaterium* activity was recorded in S: So: FYM (0.07). the results are in conformity with the findings of Selvi Ranganathan and Augustine (1997), who reported that the increase in growth parameters of tomato in nursery is due to combined inoculation of *A. chroococcum*, *B. megaterium* and *T. harzianum* which resulted in better supply of N and P to the seedlings in addition to growth promoting substances produced by these organisms.

Influence of enriched *Hypsizygous ulmaris* spent coir pith (*Hg* SCP) on tomato nursery was observed At 25 DAS and the results are presented in Table 2. Maximum shoot and root length was observed in the treatment S: So: *Hg* SCP: consortia (14.1 and 11.97 cm respectively) followed by S: So: *H*g SCP: *T. harzianum* (13.6 and 11.32 cm respectively) and S:So: *Hg* SCP: *B. megaterium* (11.96 and 10.9 cm respectively) which is on par with S:So: *Hg* SCP: *A. chroococcum* (11.93 and 10.04 cm respectively). The lowest shoot and root length was recorded in the treatment S: So: FYM (9.76 and 7.3 cm respectively). Treatment S: So: *Hg* SCP: consortia differed significantly with all the treatments with respect to shoot length. The results are in agreement with Geetha *et al*. (2005).

Maximum fresh and dry weight of shoot was recorded in S:So: *Hg* SCP: consortia (17.15 and 1.94 g respectively) Minimum fresh and dry weight of shoot was observed in the S: So: FYM (9.29 and 1.02 g respectively).Maximum fresh and dry weight of root was observed in S: So: *Hg* SCP: Consortia (8.02 and 1.34 g respectively) Minimum fresh weight of tomato roots was observed S: So: FYM (4.4 and 0.44 g respectively) Dayananda and Mallesha (2009). (Table 2)

At 25 DAS maximum dehydrogenase activity was recorded in S:So:*Hg*SCP: consortia (0.224) which is on par with S:So: *Hg* SCP: *T. harzianum* (0.274) followed by S:So: *Hg*SCP (0.219) and is on par with S:So:*Hg*SCP: *B. megaterium* (0.213). Minimum dehydrogenase activity was recorded in S: So: FYM (0.07). Ahlawat *et al*. (2009) also reported that amending the arable soil with 6 to 24 months old SMS at the rate of 25 tonnes/ha, enhanced the vegetative growth, yield and quality of tomato over FYM and control treatments, and the effect was on par with recommended dose of fertilizers.

CONCLUSION

The present study reveals that *H. ulmaris* spent coir pith with consortia of beneficial microorganisms along with sand and soil found to be better nursery mix compared to individual inoculation of beneficial microorganisms for growth of tomato seedlings. Mushroom (*H. ulmaris*) spent paddy straw and coir pith enriched with benificial microorganisms could be effectively used in nursery for growing tomato seedlings.

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