KATHMANDU UNIVERSITY JOURNAL OF SCIENCE, ENGINEERING AND TECHNOLOGY
VOL. 5, No. II, SEPTEMBER, 2009, pp 66-71.

RECYCLING OF SPENT OYSTER MUSHROOM SUBSTRATE TO RECOVER ADDITIONAL VALUE

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Received 18 May, 2009; Revised 9 August, 2009

ABSTRACT

After the cultivation of *Pleurotus eous*, possibilities of reutilization of spent mushroom substrate (SMS) was carried out in form of ingredient for the cultivation of three oyster species, viz., *Pleurotus sajor-caju* Strain- Malasia, *Pleurotus florida* Strain-P1 and *Pleurotus flabellatus* and as fertilizer for growing *Spinacea oleracea*. As an ingredient, it was mixed properly with fresh wheat straw @ 10,15 and 25 % where 25% SMS supplemented sets showed significant yield and biological efficiency of mushrooms than control. It was recorded 345 gm, 69%; 565 gm, 113% and 525 gm, 105% for *Pleurotus sajor-caju* Strain- Malasia, *Pleurotus florida* Strain-P1 and *Pleurotus flabellatus* respectively. For use as a fertilizer, SMS was infested in to the soil at three different proportions (1, 3 and 5%). It showed quick seed emergence and higher yield than pure soil, however, the yield was recorded significant only in 5% SMS containing sets.

Key words: Spent Mushroom Substrate, Fertilizer, Growing media.

INTRODUCTION

The substrate obtained from spent beds do not support good yield when respawned over it. During cultivation of mushrooms on fresh substrate, there is a gradual depletion of nutrients due to their subsequent utilization of mushroom mycelium. Good growth and better yield of mushroom can be achieved when such substrates are supplemented with starch, peptone and wheat bran (Sharma and Jandaik, 1985). The growth of Pleurotus on lignocellulosic materials depends largely upon Carbon : Nitrogen ratio in the substrate, therefore, addition of nitrogen to depleted substrate may enhance the yield performance of mushroom species (Azizi *et al.*, 1990; Gupta and Vijay, 1991).

Spent substrate obtained from leaf stalk biomass of coconut palm has been considered superior in respect of major nutrients to be used as nitrogen source in agricultural (Bhawna and Thomas, 2003). The Pleurotus has capability of converting lignocellusic material in to more digestible protein rich cattle feed (Zadrazil, 1977, 1980). Therefore, there is a good potential for reutilization of spent mushroom bed for the cultivation of mushroom after supplementation of certain organic and inorganic materials.

MATERIALS AND METHODS

The work was carried out in Mushroom Research Laboratory, K.S.S. P.G. College, Faizabad during 2005-2006. The pink oyster mushroom *Pleurotus eous* was cultivated on wheat straw substrate. After the final harvest, yield, biological efficiency, and number and weight per sporocarp (301 gm, 60.2 %, 44 and 6.95 gm respectively) were recorded and spent mushroom substrate (SMS) was reutilized in following ways:

As ingredient in the cultivation of other oyster mushroom species

The fresh wheat straw was used as a substrate for the cultivation of three Pleurotus spp. viz., *P. sajor-caju* Strian-Malaysia, *P. florida* Strain-P1 and *P. flabellatus.* It was washed in fresh water and then pasteurized in the solution of Formaldehyde (500 ppm) and Bavistin (75 ppm) for 18 hours as recommended by Vijay and Sohi (1987). Spent substrate, left after cultivation of *Pleurotus eous* was then autoclaved and mixed with this substrate at the rate of 10, 15 and 25 per cent. The beds were then prepared by layer spawning following the procedure adopted by Bano (1971). These were incubated in cultivation room at 22-30 °C temperature for spawn run. When mycelia had completely covered the bed the polythene covering was removed and relative humidity was maintained 85-95 per cent with the help of humidifier. Time lapsed in spawn run, pin head initiation, yield and biological efficiency of mushroom was separately recorded for each oyster mushroom species. The biological efficiency of mushroom was calculated out as used by percent yield of fresh mushroom in relation to dry weight of substrate by Chang and Miles (1989).

As a fertilizer

For its use as fertilizer, spent straw was milled and sieved through 0.2 cm sieves. Three different proportions 1, 3 and 5 % (w/w) were added to the soil as adopted by Shukry *et al.*, (1999). Each proportion was mixed thoroughly with the soil and placed in 15 cm diameter pot. Fifteen seeds of test plant (*Spinacea oleracea*) were sown 0.5" deep in this mixture and growth in respect of yield (gm) was recorded.

Completely Randomized Design (CRD) was employed for each experiment. The data were statistically analyzed and the critical difference (CD) was worked out at five percent probability level.

RESULTS

The results were presented in Tables 1-2 and Figure 1.

As ingredient for the cultivation of other oyster mushroom species

The spent mushroom substrate (SMS) supplemented sets gave higher yield and biological efficiency than un-supplemented sets (Control) which increased with increase in proportion of SMS supplementation. In case of *Pleurotus sajor-caju* Strain- Malaysia and *P. flabellatus*, it was recorded significant only in 25 % SMS supplemented sets (345 gm, 69 % and 525 gm, 105 % respectively) while in *P. florida* Strain P1, the significant yield and biological efficiency was observed in 15 % and 25 % of SMS supplemented sets (550 gm, 110% and 565 gm, 113 % respectively) which were at par to each other. None of the sets produced significant number and average weight per sporocarp (Table.1).

As fertilizer

The results indicated that SMS containing sets showed early seed germination than pure soil. The time of germination decreased with increasing proportion of SMS and recorded minimum in 5% SMS proportion sets. However, such trends were not observed in harvesting time where all the sets took equal time (37 days). The yield of *Spinacia oleracea* was observed higher in all the treatments. It was recorded significant only in 5% SMS containing sets (120 gm). The result also revealed that supplementation of higher dose of SMS not only decreased the time of germination but also increased the yield performance of *Spinacia oleracea*. (Table-2)

DISCUSSION

The spent mushroom substrate was utilized as ingredient in the cultivation of three *Pleurotus* spp, viz., *P. sajor-caju* Strain-Malaysia, *P. florida* Strain P1 and *P. flabellatus*, where all of them showed highest yield and biological efficiency in the sets supplemented with 25% proportions of SMS. This might be due to presence of additional nutrients in SMS. Sharma and Jandaik (1985) reported recycling of Pleurotus waste for the cultivation of *Pleurotus sajor-caju* and found significant yield of *Pleurotus sajor-caju* on starch, peptone and wheat bran supplemented spent mushroom substrate. Nakaya *et al.*, (2000) recycled *Pleurotus cornucopiae* waste for the cultivation of two oyster species viz., *P. cornucopiae* and *P. ostreatus*.

The seeds of *Spinacia oleracea* took shorter time for germination in SMS supplemented sets. Results also indicated the positive effect of SMS on yield of *Spinacia oleracea* where its high Proportion showed significant production of crop. This may be because of the SMS improved the physical property of soil by decreasing soil bulk density, increasing aggregate stability, reducing surface crust formation and diurnal temperature changes, increasing the infiltration rate, aeration and water retaining capacity of the soil. It is well known that physical properties of soil were directly related to crop yield (Stewart *et al.*, 1998). It also maintains high organic matter content in the soil. Zheng and co-worker stated that it contains higher percentage of three primary nutrients e.g. nitrogen, phosphorus and potassium as a fertilizer (Rinker *et al.*, 2004) while Zadrazil (1976) suggested that during growth on straw, Pleurotus releases humic acids like fractions when added to soil which increase its fertility. In addition, humic substances may affect the plant biochemical process (Vaughan *et al.*, 1985). Shukry *et al.* (1999) reported that addition of straw in the soil caused an increase in the number of total bacteria, actinomycetes and fungi of the rhizosphere. Ranyanathan and Selvaseelan (1994) observed that the yield of green gram increased in plots previously supplied with mushroom spent rice straw. Recently, López Castro *et al.*, (2008) stated that Pleurotus waste was adequate to sustain the growth of *Salvia officinalis* by improving air porosity and mineral content of the soil.

ACKNOWLEDGEMENT

We are thankful to Dr. B. P. Verma, C.S.A. University of Agriculture and Technology, Kanpur for providing culture and Principal K.S.S. P.G. College, Ayodhya for laboratory facilities.

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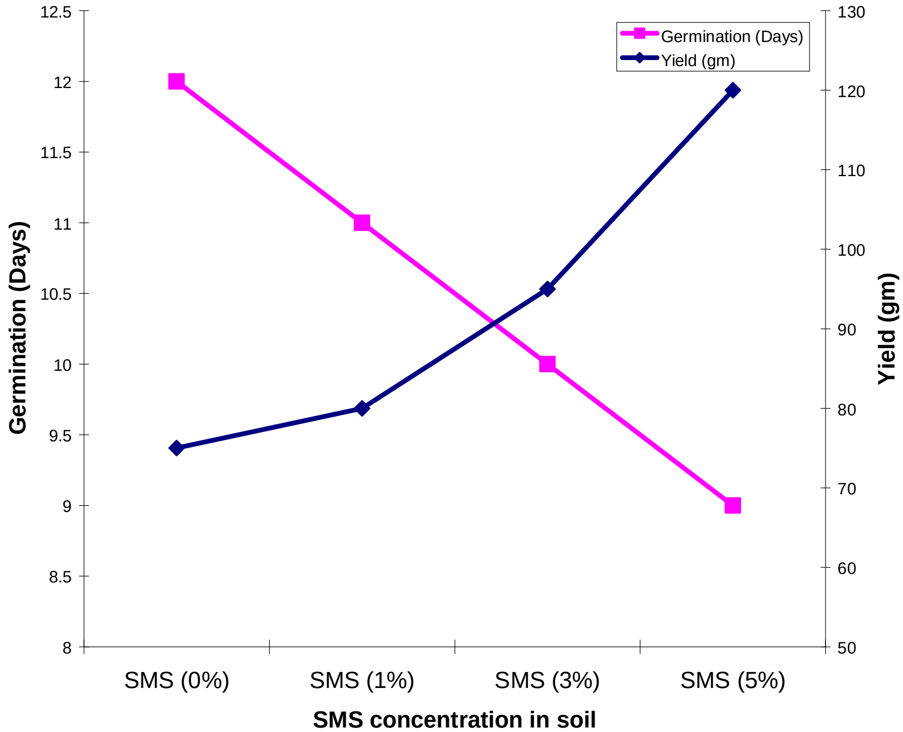

Fig 1. Effect of spent mushroom substrate (SMS) as fertilizer on germination and yield of *Spinacia oleracea*.

SMS (Conc.)	*P. Sajor- caju* Strain- Malaysia				*P. florida* Strain P1				*P. flabellatus*			
	Yield [gm/500 gm dry substrate]	Biological efficiency (%)	Number of sporocarp	Weight per sporocarp (gm)	Yield [gm/500 gm dry substrate]	Biological efficiency (%)	Number of sporocarp	Weight per sporocarp (gm)	Yield [gm/500 gm dry substrate]	Biological efficiency (%)	Number of sporocarp	Weight per sporocarp (gm)
SMS (10%)	310	62	49	6.32	545	109	47	11.59	485	97	61	7.95
SMS (15%)	325	65	47	6.91	550	110	48	11.45	495	99	55	9.00
SMS (25%)	345	69	60	5.75	565	113	50	11.30	525	105	66	7.95
Control	300	60	47	6.38	515	103	49	10.51	470	94	60	7.83
SE	18.88	3.77	5.81	0.57	13.38	2.67	1.11	1.31	17.79	3.55	5.74	0.67
CD (P=0.05%)	43.61	8.70	13.43	1.31	30.91	6.18	2.58	3.04	41.10	8.22	13.26	1.54

Table1. Effect of SMS supplementation on yield performance and biological efficiency of oyster mushroom species.

Table 2. Effect of SMS (as fertilizer) on growth and yield of *Spinacea oleracea*.

Spent Mushroom Substrate (Conc.)	Germination (Days)	First Harvest (Days)	Yield (gm)
SMS (1%)	11	37	80
SMS (3%)	10	37	95
SMS (5%)	09	37	120
Control	12	37	75
SE	-	-	14.28
CD (P=0.05)	-	-	33.00