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Effect of *Hypsozygous ulmarius* Spent Substrate on Microbial Population in Rhizosphere Soil of Aerobic Rice

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The substrates *viz*., Paddy straw, coir pith and jatropha husk were used for the cultivation of *Hypsozygous ulmarius* mushroom. After the cultivation of *Hypsozygous ulmarius* mushroom, the spent substrates alone and in combination with compost were used to know the effect on microbial population (total bacteria, fungi, actinomycetes, *Azotobacter* and phosphate solubilizing bacteria) at different growth stages (Sowing, tillering, panicle initiation and flowering) of aerobic rice in rhizosphere soil. The results of the green house experiment indicated significantly highest microbial populations (total bacteria, fungi, actinomycetes, *Azotobacter* and phosphate solubilizer) were recorded with Sand+Soil+*Hypsozygous ulmarius* spent jatropha husk+compost. However, it was followed by Sand+Soil+*Hypsozygous ulmarius* spent paddy straw+compost and the lowest was recorded in Sand+Soil+*Hypsozygous ulmarius* spent coir pith respectively.

Key words: *Hypsozygous ulmarius*, Spent mushroom substrate, Microbial population and Rhizosphere soil.

Mushrooms are fruiting bodies of basidiomycotina and ascomycotina fungi. They include edible, medicinal and poisonous species. There are 2,000 species of mushroom fungi, which belonging to 31 genera, among these 100 species can be cultivated artificially, but only 30 species are commercially cultivated all over the world. So far 1800 species of mushroom fungi have been proved for their medicinal values, and 10 per cent of the total mushrooms are poisonous. (Chang and Miles, 1997).

Mushrooms are capable of degrading agro-waste. Most of the edible fungi produce the enzyme complexes which degrade cellulose, hemicellulose, and lignin of agricultural waste and industrial byproducts and there by resulting in high valued edible mushrooms with appreciable flavor and better nutritive values. Mushrooms are considered as good vegetables containing high protein (20 to 40 per cent on dry weight basis) and less fat (less than 1 to 8 per cent) and have all essential amino acids and vitamins. Further mushrooms are lower in calories.

After cultivation of mushroom, Spent mushroom substrate adds nutrients, organic matter and act as a both organic manure and growth promoting substances to rhizosphere as exudates, there by microbial population of soil will also increases. It's a soil-like material remaining after a crop of mushrooms. It adds nutrients to soil, helps to neutralize acidic soils, facilitates plant growth in barren areas and in some cases, adds organic matter and structure to the soil (Yadav *et al*., 2001). Due to rich nutritional content of mushroom spent

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substrates, enhances the microbial population in rhizosphere soils (Mallesha, 2008).

MATERIALS AND METHODS

The enumeration of total bacteria, fungi, actinomycetes, *Azotobacter* and phosphate solubilizing bacteria. the rhizosphere soil samples was carried out at sowing, tillering and panicle initiation flowering stages of aerobic rice by following the standard dilution plate count technique. Soil extract agar for bacteria, Martin's Rose Bengal with streptomycin sulphate agar for fungi, Kuster's agar for actinomycetes, Waksman's medium for Azotobacter, Pikovoskaya's medium for phosphate solubilizer were used for enumeration. The Petriplates were incubated at 30^{0}C for three to six days and population was counted and expressed per unit dry weight of substrate.

A green house experiment was conducted at Department of Agricultural Microbiology, UAS, GKVK, Bengaluru-65. The battery boxes of 50 cm × 30 cm were filled with *Hypsozygous ulmarius* mushroom spent paddy straw, jatropha husk, coir pith in combination with Soil : Sand : Compost, in the ratio of 2:1:1 at the rate of 15 kg per box for the growth of aerobic rice (MAS-99). In the treatments instead of compost, mushroom spent substrates alone or in combination with compost was used. Following treatment combinations were used.

T_1 – Soil + Sand + Compost (Control)
(7.5 + 3.75 + 3.75 = 15 kg)

T_2 – Soil + Sand + *Hypsozygous ulmarius* mushroom spent paddy straw
(7.5 + 3.75 + 3.75 = 15 kg)

T_3 - Soil + Sand + *Hypsozygous ulmarius* mushroom spent coir pith
(7.5 + 3.75 + 3.75 = 15 kg)

T_4 - Soil + Sand + *Hypsozygous ulmarius* mushroom spent jatropha husk (7.5 + 3.75 + 3.75 = 15 kg)

T_5 - Soil + Sand + Compost + *Hypsozygous ulmarius* mushroom spent paddy straw (7.5 + 3.75 + 1.875 +1.875 = 15 kg)

T_6 - Soil + sand + Compost + *Hypsozygous ulmarius* mushroom spent coir pith (7.5 + 3.75 + 1.875 +1.875= 15 kg)

T_7 - Soil + Sand + Compost + *Hypsozygous ulmarius* mushroom spent jatropha husk (7.5 + 3.75 + 1.875 +1.875 = 15kg).

RESULTS AND DISCUSSION

Significantly highest microbial population (total bacteria, fungi, actinomycetes, Azotobacter and phosphate solubilizer) were found in **T_7** (Soil + Sand + Compost + *Hypsozygous ulmarius* mushroom spent jatropha husk) followed by **T_5** (Soil + Sand + Compost + *Hypsozygous ulmarius* mushroom spent paddy straw) and the lowest microbial populations were found in **T_3** (Soil + Sand + *Hypsozygous ulmarius* mushroom spent coir pith) during different growth stages (sowing, tillering, flowering and harvesting) of aerobic rice rhizosphere soil (table 1, 2, 3, 4 and 5).

Table 1. Effect of *Hypsozygous ulmarius* spent substrates on bacterial population at different growth stages of aerobic rice

Treatments	At sowing (No. x 10^6 cfu / g)	Tillering stage (No. x 10^6 cfu / g)	Panicle initiation stage (No. x 10^6 cfu / g)	Flowering stage (No. x 10^6 cfu / g)
T_1 = S_a:S_i: Co	20.00^a	25.67^{abc}	31.33^b	40.33^b
T_2 = S_a:S_i :*Hu*SPS	15.33^b	27.33^{ab}	37.00^a	41.00^b
T_3 = Sa:S_i : *Hu*SCP	11.00^c	23.33^c	27.00^c	33.33^c
T_4 = Sa:S_i : *Hu*SJH	15.67^b	27.67^{ab}	37.67^a	41.00^b
T_5 = Sa:S_i : *Hu*SPS + Co	19.67^a	28.00^{ab}	38.00^a	42.00^b
T_6 = S_a:S_i : *Hu*SCP + Co	15.00^b	25.00^{bc}	28.33^{bc}	35.33^c
T_7 = Sa:S_i : *Hu*SJH + Co	20.67^a	29.00^a	40.00^a	51.00^a
SEm±	0.45	0.76	0.84	1.04
C. D. at 5%	1.37	2.32	2.56	3.17

S_a = Sand , S_i = Soil, Co = Compost, *Hu*SPS = *Hypsozygous ulmarius* spent paddy straw , *Hu*SCP = *Hypsozygous ulmarius* spent coir pith, *Hu*SJH = *Hypsozygous ulmarius* spent jatropha husk.

The total microbial population, *Azotobacter*, phosphate solubilizers populations were more in case of soils treated with spent mushroom substrate in combination of jatropha husk + compost. This may be due to nutritional or chemical composition of the substrate. A similar trend was reported by Mallesha (2008) with *P. florida* spent mushroom substrate application to soil.

From these results, it is clearly evident that mushroom spent substrate has positive effect on rhizosphere microorganisms. This can be attributed to the fact that the spent substrate is a source of organic matter rich in readily available nutrients and also promotes the release of various growth promoting substance to the rhizosphere as exudates. So, these factors enhance the proliferation of microorganisms and their activities. Moreover, microbiological and biochemical properties are very responsive and provide immediate and precise information on small changes occurring in soil.

Similar trend in results was also reported by various authors. Dinesh *et al.* (2000) reported that the spent mushroom substrate acts as a organic manure, which enhances the microbial activity. The maximum bacterial population was significantly influenced by mushroom spent substrate treated soils. This may be due to nutrients released from plant root exudate, which enhances the microbial activity in soil.

Rashad *et al.*, (2010) in their study on

Table 2. Effect of *Hypsozygous ulmarius* spent substrates on fungi population at different growth stages of aerobic rice

Treatments	At sowing (No. x 10^6 cfu / g)	Tillering stage (No. x 10^6 cfu / g)	Panicle initiation stage (No. x 10^6 cfu / g)	Flowering stage (No. x 10^6 cfu / g)
T_1 = S_a:S_i: Co	5.67^{cd}	10.67^{ab}	10.67^{cde}	12.33^{bc}
T_2 = S_a:S_i :*Hu*SPS	6.00^{c}	10.67^{ab}	11.33^{bcd}	12.67^{bc}
T_3 = Sa:S_i : *Hu*SCP	4.00^{e}	9.67^{b}	10.00^{e}	10.67^{d}
T_4 = Sa:S_i : *Hu*SJH	7.00^{b}	11.00^{ab}	11.67^{bc}	13.00^{bc}
T_5 = Sa:S_i : *Hu*SPS + Co	8.33^{a}	11.00^{ab}	12.00^{b}	13.67^{b}
T_6 = S_a:S_i : *Hu*SCP + Co	5.00^{d}	10.33^{b}	10.33^{de}	11.67^{cd}
T_7 = Sa:S_i : *Hu*SJH + Co	9.00^{a}	12.00^{a}	13.67^{a}	15.33^{a}
SEm±	0.17	0.33	0.28	0.30
C. D. at 5%	0.54	1.01	0.85	0.93

S_a = Sand , S_i = Soil, Co = Compost, *Hu*SPS = *Hypsozygous ulmarius* spent paddy straw , *Hu*SCP = *Hypsozygous ulmarius* spent coir pith, *Hu*SJH = *Hypsozygous ulmarius* spent jatropha husk.

Table 3. Effect of *Hypsozygous ulmarius* spent substrates on actinomycetes population at different growth stages of aerobic rice

Treatments	At sowing (No. x 10^6 cfu / g)	Tillering stage (No. x 10^6 cfu / g)	Panicle initiation stage (No. x 10^6 cfu / g)	Flowering stage (No. x 10^6 cfu / g)
T_1 = S_a:S_i: Co	5.00^{c}	5.67^{d}	11.67^{cd}	12.00^{d}
T_2 = S_a:S_i :*Hu*SPS	4.67^{c}	6.00^{d}	12.00^{cd}	12.33^{cd}
T_3 = Sa:S_i : *Hu*SCP	3.00^{e}	4.00^{e}	10.00^{e}	9.67^{e}
T_4 = Sa:S_i : *Hu*SJH	5.00^{c}	7.00^{c}	13.00^{bc}	13.33^{bc}
T_5 = Sa:S_i : *Hu*SPS + Co	6.00^{b}	8.00^{b}	13.67^{b}	14.33^{b}
T_6 = S_a:S_i : *Hu*SCP + Co	4.00^{d}	5.33^{d}	11.33^{d}	11.67^{d}
T_7 = Sa:S_i : *Hu*SJH + Co	7.00^{a}	9.00^{a}	15.00^{a}	16.00^{a}
SEm±	0.12	0.17	0.30	0.28
C. D. at 5%	0.38	0.54	0.93	0.85

S_a = Sand , S_i = Soil, Co = Compost, *Hu*SPS = *Hypsozygous ulmarius* spent paddy straw , *Hu*SCP = *Hypsozygous ulmarius* spent coir pith, *Hu*SJH = *Hypsozygous ulmarius* spent jatropha husk.

effect of rice straw compost on soil microbial population reported that, compost application resulted in marked increase of organic matter content into soil in relation to initial value of plain sandy soil which affirmatively exaggerated the bacterial and fungal populations; as the compost dosage increased the maximum population obtained. In addition, apart from microbial proliferation may be referred to plant root exudates which support the microbial growth in the rhizosphere. Such increase of microbial population might be due to the availability of growth nutrients

Table 4. Effect of *Hypsozygous ulmarius* spent substrates on Azotobacter population at different growth stages of aerobic rice

Treatments	At sowing (No. x 10^6 cfu / g)	Tillering stage (No. x 10^6 cfu / g)	Panicle initiation stage (No. x 10^6 cfu / g)	Flowering stage (No. x 10^6 cfu / g)
T_1 = S_a:S_i: Co	6.00^{b}	6.33^{d}	10.33^{c}	11.33^{c}
T_2 = S_a:S_i:*Hu*SPS	4.67^{c}	7.67^{c}	11.00^{c}	12.33^{bc}
T_3 = Sa:S_i : *Hu*SCP	4.00^{d}	5.00^{e}	8.00^{e}	8.00^{e}
T_4 = Sa:S_i : *Hu*SJH	5.00^{c}	9.00^{b}	12.33^{b}	13.00^{b}
T_5 = Sa:S_i : *Hu*SPS + Co	6.00^{b}	9.67^{ab}	13.00^{b}	13.67^{b}
T_6 = S_a:S_i : *Hu*SCP + Co	4.00^{d}	6.00^{d}	9.33^{d}	10.00^{d}
T_7 = Sa:S_i : *Hu*SJH + Co	7.00^{a}	10.00^{a}	14.00^{a}	15.00^{a}
SEm±	0.12	0.21	0.21	0.30
C. D. at 5%	0.38	0.66	0.66	0.93

S_a = Sand , S_i = Soil, Co = Compost, *Hu*SPS = *Hypsozygous ulmarius* spent paddy straw , *Hu*SCP = *Hypsozygous ulmarius* spent coir pith, *Hu*SJH = *Hypsozygous ulmarius* spent jatropha husk.

Table 5. Effect of *Hypsozygous ulmarius* spent substrates on Phosphate solubilizer population at different growth stages of aerobic rice

Treatments	At sowing (No. x 10^6 cfu / g)	Tillering stage (No. x 10^6 cfu / g)	Panicle initiation stage (No. x 10^6 cfu / g)	Flowering stage (No. x 10^6 cfu / g)
T_1 = S_a:S_i: Co	6.67^{ab}	6.67^{de}	7.67^{cde}	8.67^{bcd}
T_2 = S_a:S_i:*Hu*SPS	5.67^{bcd}	7.00^{cd}	8.00^{cd}	9.00^{abcd}
T_3 = Sa:S_i : *Hu*SCP	5.00^{d}	6.00^{e}	7.00^{e}	8.00^{d}
T_4 = Sa:S_i : *Hu*SJH	6.00^{abcd}	7.67^{bc}	8.33^{bc}	9.33^{abc}
T_5 = Sa:S_i : *Hu*SPS + Co	6.33^{abc}	8.00^{b}	9.00^{b}	9.67^{ab}
T_6 = S_a:S_i : *Hu*SCP + Co	5.33^{cd}	6.00^{e}	7.33^{de}	8.33^{cd}
T_7 = Sa:S_i : *Hu*SJH + Co	7.00^{a}	9.00^{a}	10.00^{a}	10.00^{a}
SEm±	0.25	0.17	0.21	0.25
C. D. at 5%	0.76	0.54	0.66	0.76

S_a = Sand , S_i = Soil, Co = Compost, *Hu*SPS = *Hypsozygous ulmarius* spent paddy straw , *Hu*SCP = *Hypsozygous ulmarius* spent coir pith, *Hu*SJH = *Hypsozygous ulmarius* spent jatropha husk.

and positive effect of organic matter on the physical properties of soil which support the microbial growth and activity in the soil.

Applying organic amendments has been shown to increase soil microbial activity, microbial diversity, and bacterial densities (Van Bruggen and Semenov, 2000; Liu and Ristaino, 2003; Girvan *et al*., 2004).

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