Cultivation of *Pleurotus tuber-regium* (Fr) Sing on Various Farm Wastes

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Various farm wastes were investigated as substrates for *Pleurotus tuber-regium*. The highest mushroom harvest (fresh weight) was obtained from oil palm fruit fiber substrate and the lowest yield was from yam (*Dioscorea* sp.) peelings. Casing enhanced yield from all substrates. Oil palm fruit fiber spawn is an alternative to the sclerotium in propagating the fungus. Some fungi and pests were associated with the mushroom on these substrates but only *Sclerotium rolfsii* caused stipe rot.

INTRODUCTION

Pleurotus tuber-regium (Fr) Sing, an edible basidiomycete, occurs in both tropical and subtropical regions of the world (1, 2). It is a common mushroom in the southern part of Nigeria and forms large spherical to ovoid, subterranean sclerotia which sometimes measure up to 30 cm in diameter (3). The fungus infects dry wood, where it produces the sclerotium, usually buried within the wood tissues but also found between the wood and the bark. Both the sclerotium and the mushrooms are eaten in Nigeria. Sclerotia are used in various soup and medicinal preparations both for human consumption and in traditional medical practice in Nigeria (2, 3).

The fungus grows with relative ease in the laboratory and is noted for rapid growth and for causing extensive wood decay (4). Mushroom cultivation is still in its infancy in Nigeria, and many species that might be cultivated for food are known only in the wild state. The objective of this study was to evaluate the use of different farm wastes as possible substrates for the growth of *P. tuber-regium.*

MATERIALS and METHODS

Sclerotia used for this study were obtained from logs in the savanna area of Ekpoma in the Okpebho Local Government Area of Bendel State of Nigeria. They were taken to the laboratory and stored for 4-5 days at room temperature before use. The following wastes products were used: cassava (*Manihot* sp.) peelings collected fresh from a cassava mill, corn (*Zea* sp.) straw collected from the University of Benin farm, oil palm fruit fiber from the oil mill of the Nigerian Institute for Oil Palm Research (NIFOR) near Benin City, rice (*Oryza* sp.) straw from a private farm in Benin, and wild grass (*Pennisetum* sp.) collected after land preparation from the University farm.

The cassava and yam peelings were sun-dried for 10 days and crushed to coarse sizes (ca. 3 cm) with a mortar and pestle. Corn, rice, and wild grass straws were separately cut into small pieces (ca. 3 cm) and the large cylinders of straw were split into 3-4 slices. Oil palm fruit fibers were also sun-dried for 10 days before use.

The substrates were separately bulked and treated with 5% bleach (v/v) with a moisture content maintained at 70%, read with a Sargent Welch (U.S.A.) moisture meter. Two hundred grams of each of these substrates were loaded into plastic trays (30 trays), 60x60x15 cm. Controls were trays filled with 200 g of white river sand.

Each tray was seeded with 50 g of fresh sclerotia, at three different equidistant points on the tray. Trays (uncovered) were then placed in a greenhouse (25 ± 3 °C) for observation of fungal growth.

Spawn trial: Oil palm fruit fiber supported extensive growth and was tested as a spawning material. The spawn was prepared by stuffing three polyethylene bags (75 x 60 cm) with oil palm fruit fiber treated with 5% bleach (v/v) and inoculated with sclerotial pieces (25 g each), 10 to each bag, and incubated at room temperature. After 20 days, extensive and compact mycelium (mushroom "seed") had developed on the oil palm fruit fiber. The bags were opened, and the mushroom seed divided into 15-g portions and used to inoculate the different substrates. Fifteen days after "seeding," 10 trays were

TABLE 1. Average yield[a] of fresh mushrooms per tray.

Substrate	Sclerotial inoculation		Oil palm fruit fiber spawning	
	Uncased	Cased	Uncased	Cased
Cassava peelings (*Manihot* sp.)	12.85±2.20	23.45±1.70	0	6.20±0.05
Corn straw (*Zea* sp.)	6.50±0.30	19.74±1.05	8.10±3.10	64.30±2.05
Oil palm fruit fiber	0[b]	123.40±3.20	0	130.20±2.86
Rice straw (*Oryza* sp.)	13.26±3.40	39.29±2.80	6.01±0.02	26.08±1.56
Yam peelings (*Dioscorea* sp.)	10.25±1.04	15.74±0.50	0	10.10±0.50
Wild grass straw (*Pennisetum* sp.)	18.58±1.05	32.33±1.70	0	13.10±0.07
River sand	16.54±2.12[b]	---[c]	0	---[c]

[a] Yield is in grams ± standard deviation.
[b] Sclerotium failed to produce mushrooms on the rich oil palm fruit fiber owing to the extensive mycelia developed, but it formed (germinated) mushrooms directly when inoculated onto river sand.
[c] Not determined.

cased with garden top soil. Fresh mushroom yield per tray was recorded 20 days after casing. Each tray was watered once per day with 40 ml of sterile distilled water.

All fungal contaminants and other pests associated with the different substrates and mushrooms were recorded. Fungal contaminants growing directly on the sporophores and causing damage or disfigurement were isolated on potato dextrose agar (PDA) medium and later subcultured. Pathogenicity tests for each isolate were carried out using Kochs' postulate (5).

RESULTS and DISCUSSION

Higher yields were produced on substrates inoculated with sclerotia than for those inoculated with spawn, except for the oil palm fiber and corn straw substrates (Table 1). Sclerotia grow directly into sporophores and mycelium. This is not the case with spawn, which has to develop extensive mycelium before fruiting, and the more the mycelium developed, the greater the yield (6). Hence, the better developed mycelium on oil palm fruit fiber supported the highest sporophore production. Although the substrates were not analyzed for nutrients, the extensive mycelial development on oil palm fiber indicates that it is a rich medium for the growth of this mushroom.

Higher yields were recorded on substrates cased than those without casing (Table 1). This confirms the general observations that casing enhances cropping (7). This was best illustrated with oil palm fiber-spawn-treatments, which produced mainly vegetative mycelia with little or no yield from uncased substrates. The role of casing in mushroom cultivation has been principally associated with aiding the change from the vegetative phase (mycelium) to a reproductive phase (fruiting) (7, 8).

All the substrates bore different fungal contaminants (Table 2). While *Aspergillus* sp., *Penicillium* sp., and *Rhizopus stolonifer* occurred on cassava and yam peelings, *Xylaria* sp. and *Physarum* sp. grew on corn and rice straw. *Botryodiplodia* sp. occurred more specifically on yam peelings. These results appear to be related to the ecological disposition of these fungi: storage fungi, such as *Aspergillus, Penicillium,* and *Rhizopus* occurred on yams and cassava, and the higher lignicolous species such as *Xylaria* occurred on corn and rice straw. *Physarum* sp. occurred frequently on straw. Most fungi are found on particular substrates (e.g., *Coprinus filmentarius* colonizes mushroom composts in which ammonia and amines accumulate) (6). Also, *Botryodiplodia theobromae* is commonly associated with cassava tuber (9). Oil palm fiber supports a very low incidence of *Aspergillus*, perhaps because of rapid colonization of the substrate by the mycelium of *Pleurotus tuber-regium.*

Mushrooms, like any other cultivated crop, are attacked by pests and competitors. In this study, *Sclerotium rolfsii* was the only fungus that caused stipe rot while others caused crop failure or disfigurement of the mushrooms (Table 2). The stipe rot appeared as a yellowish brown rot on the stipe, which prevented the formation of a cap. The stipe gradually deteriorated and disintegrated into the substrate. *S. rolfsii* is a soil-borne pathogen, especially in subtropical and tropical countries, causing diseases ranging from root rot to fruit rot (1, 11). Its pathogenicity on mushrooms has not been previously reported. This disease occurred on mushrooms developed on substrates that were cased, which suggests that the fungus may have ori-

ginated from the casing garden soil. To avoid use of soil contaminated with *S. rolfsii*, casing soil could be screened for this fungus before use with a baiting technique. The disfigurement on mushrooms as a result of fungal stains generally lowers the commercial value of the mushrooms. However, strict maintenance of high standards of hygiene during cultivation will reduce occurrence of fungal contaminants.

TABLE 2. Common fungal weeds and pests associated with the mushroom.

Fungal species/Pests	Effect[a]	State of mushroom[b]
Aspergillus flavus Link	COS	NA
Aspergillus niger van Tiegh	SG;DM	IS
Aspergillus tamarii Kita	COS	NA
Botryodiplodia theobrome Sacc.	COS	NA
Coprinus comatus Gray	COS	NA
Sclerotium rolfsii Sacc.	Stipe rot	IS
Penicillium sp.	SG;DM	IS
Physarum polycephalum Schw.	COS	NA
Rhizopus stolonifer Lind	COS	NA
Schizophyllum commune Fr.	COS	NA
Xylaria hypoxylon Grey	COS	NA
Insects	DM	IS;MS
Nematodes	SNF	sporophore primordia

[a] COS = contaminant on substrate; SG = stunted growth; DM = disfigurement of mushroom; SNF = sporophores not formed.
[b] Before attack; NA = not applicable; IS = immature sporophore; MS = mature sporophore.

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