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Research Article

CIENT PERIODIQUE

Growth Pattern and Pests of the Mushroom *Pleurotus tuber-regium* (Fr.) Singer Found in Awka, Nigeria

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Abstract

Mushrooms which are saprophytes have been used in biodegradation. *Pleurotus tuber-regium* (Fr.) Singer, is the most common edible saprophytic mushroom in Nigeria especially, among those living in the South-East. This work studied the conditions necessary for the growth of this mushroom and its insect pests. Time of insect pest infestation and its abundance in the growing environment, was also examined. Top soil was used as substrate while the sclerotium was bought from Eke-Awka market, Awka. After planting the sclerotia into the substrates, they were placed in five different locations namely: under tree (A), inside laboratory (B), shaded area (C), inside cupboard (D) and under sun (E). The substrates were monitored for emergence of sporophores and the different stages of pest infestation. The following insect pests; *Alphitobius* sp., larvae of *Alphitobius* sp.; larvae of *Bradysia* sp.; *Staphlinus* sp. and *Scaphisoma* sp. were observed to be associated with the growth of *Pleurotus tuber-regium* in Awka, Anambra State. The insect pests attacked the sporophore from the sixth day after emergence. The fruit bodies observed for 10 days revealed that *P. tuber-regium* gave highest primordial length increase (1.41±0.01cm to 10.80±0.01cm) in Location D and lowest (4.90±0.00cm to 7.10±0.00cm) in Location A. Result of the percentage occurrence of insects revealed that the larvae of *Bradysia* sp. gave highest occurrence in Location B (15.38±0.00 %). In comparison between locations, the occurrence of insects was higher in Location A

(16.92±11.41%). The result revealed that of the entire insect pest that attacked *P. tuber-regium* in this study, *Alphitobius* sp. and its larvae caused the most significant damage to the mushroom body. The study showed that, the occurrence, abundance, severity and activity of these mushroom insect pests are dependent on the environment of the mushroom.

Introduction

Mushroom, called "Elo" in Igbo language of Nigeria is a fleshy, spore bearing fruiting body, typically grown above the ground on soil or in its food sources [1]. Most mushrooms belong to the phylum Basidiomycota that have a stem (stipe), a cap (pileus) and gills (lamellae) on the other side of the cap [2]. It is a macrofungus with a distinctive fruiting body which can be either epigeous or hypogeous and large enough to be seen with the naked eye [3]. In Anambra State, indigenes gave several reasons for mushroom consumption which include; for medicinal purposes, as substitute for meat, soup thickening, nutritional values and palatable taste (Okigbo and Nwatu, 2012) [4].

Mushrooms like other cultivated vegetable crops are subject to attack by pests and pathogens [5]. A pathogen is anything that can produce disease. Typically, the term is used to describe an infectious agent such as a virus, bacterium, prion, a fungus or even another micro-organism [6]. A pest is any living organism, whether animal, plant or fungus, which is invasive or troublesome to plants, animals, human or human concerns [7]. The major constraint to mushroom production as shown by Onwubuya *et al.*, (2015) [5] is pest infestation (77.7%) and shortage of water (70.5%).

Aim of this work therefore, is to identify the pests and pathogen that hinder the successful cultivation of *Pleurotus tuber-regium* in Awka Anambra State, Nigeria. The objective also is to monitor the growth stages to know the pest infestation at each stage

Materials and Methods

Site Preparation

The work was done in two parts. The first involved growing sporophores from *P. tuber-regium* sclerotia, while the second part dealt with monitoring the mushrooms at different stages for pest infestation. This experiment was carried out within the premises of the Department of Botany Laboratory, Nnamdi Azikiwe University, Awka.

Growing of Mushroom from Sclerotia

The sclerotia were prepared for planting by adopting the method of Oghenekaro *et al.*, (2008) and Okigbo *et al.*, (2015) [8,9]. The experiment was closely observed for sporulation of the sclerotia and then watered twice daily (9am and 4pm) with clean tap water (20ml) to ensure that the environment was kept humid. Recording commenced twenty days later when primordial formation started.

Mushroom Data Collection

The mushroom yield was determined using the following parameters as measured with centimeter rule.

Stipe Length: Measured by placing centimeter rule from the base of stipes to its pileus.

Cap Diameter: Measured by placing centimeter rule from one edge of the pileus across the stipe to the other edge.

Stipe Girth: Measured by tying a thread gently round the stipe in a firm way, then stretch it on centimeter rule to take readings.

Insect Pest Data Collection

The following parameters; insect type, abundance/population and its character(s) were recorded. They were removed from the mushroom samples by hand picking method and preserved in 4% formalin [10]. Traits of captured insects were compared with what is already written in literature [11]. This was confirmed by Prof. N. J. Okonkwo of Crop Science Department, Nnamdi Azikiwe University Awka.

Harvesting of Mushroom

The mushroom were harvested eleven days after primordial emergence by placing one of the index fingers on the surface of the substrate (to prevent the entire sclerotia from coming out with sporophore) and with the other hand holding the base of the stipe, the sporophore is twisted and pulled out from sclerotia within the substrate. The sporophore was taken into the Laboratory for recording of their parameters like: fresh and dry weight, height of mushroom, insect type, among others.

Statistical Analysis

The data collected were subjected to Analysis of Variance (ANOVA) using general linear model option SAS. Test of significance was determined by Duncan's multiple range test at 5% level of probability.

Results

Percentage Occurrence of Green Mould Disease in the Study Locations:

The Result of the percentage occurrence of green mould disease in the study locations revealed that green mould disease recorded 100% occurrence in location C and 0% occurrence in other locations (Table 1). There was no growth observed in location E.

Table 1: *Percentage occurrence of green mould disease in the locations*

Locations	% Occurrence
A	0.00
B	0.00
C	100.00
D	0.00
E	0.00

Primordial Length, Cap Diameter and Stipe Girth of *P. Tuber-Regium* Cultivated in Different Locations

Primordial Length of P. Tuber-Regium Cultivated in Different Locations: *P. tuber-regium* gave highest primordial length increase (10.80±0.007cm) in Location D and lowest (7.10±0.000cm) in Location A. There was a significant difference in the primordial length of *P. tuber-regium* between the locations at 2nd, 6th, 7th, 8th, 9th, and 10th day ($p<0.05$) (Fig. 1).

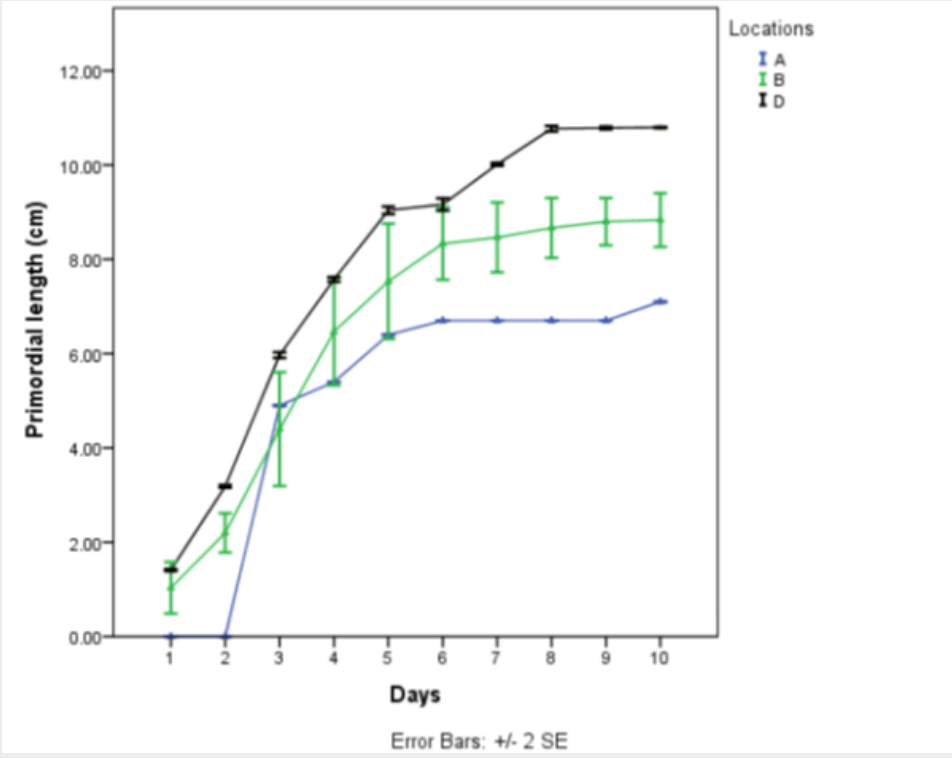

Figure 1: *Primordial length of Pleurotus tuber-regium at different locations*

Cap Diameter of P. Tuber-Regium Cultivated in Different Locations: *P. tuber-regium* gave highest cap diameter increase (8.75±1.136cm) in Location B and lowest (1.23±0.035cm) in Location D. There was a significant difference in the cap diameter of *P. tuber-regium* between the locations from the 5th day to the 10th day ($p<0.05$) (Fig. 2).

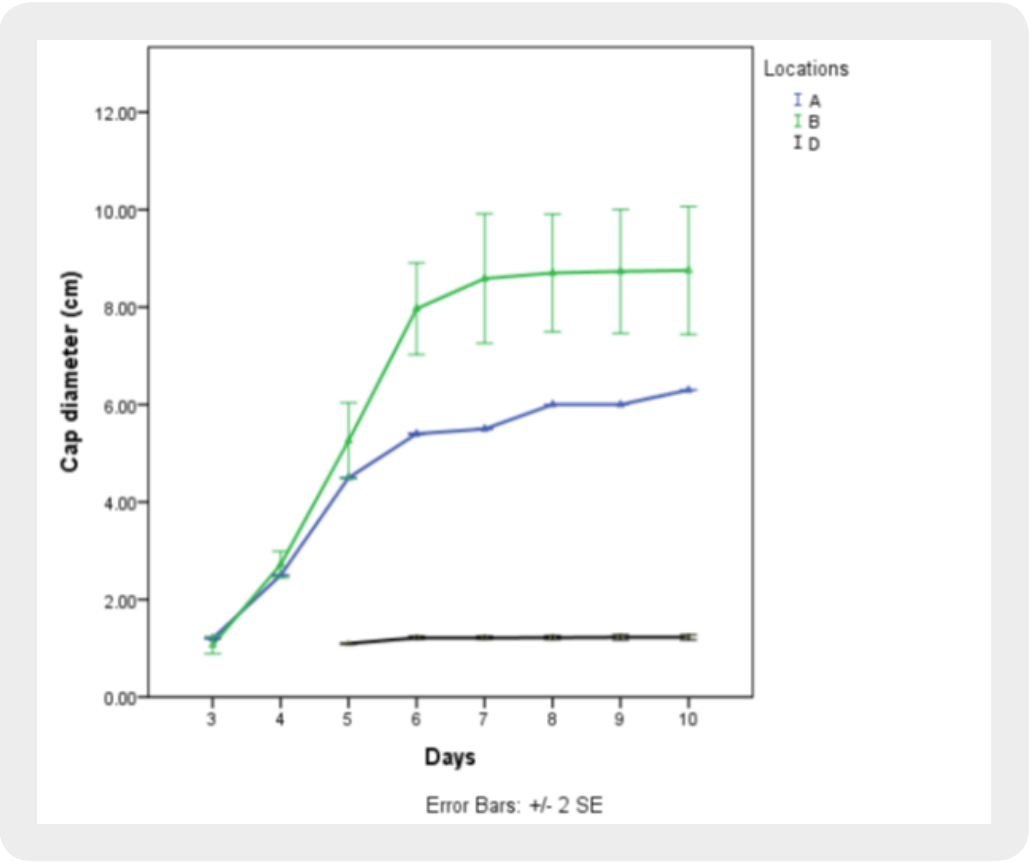

Figure 2: *Cap Diameter of Pleurotus tuber-regium at different locations*

Stipe Girth of P. Tuber-Regium Cultivated in Different Locations: *P. tuber-regium* gave highest stipe girth increase (4.53±0.839cm) in Location B and lowest (3.60±0.007cm) in Location A. There was a significant difference in the stipe girth of *P. tuber-regium* between the locations from the 3rd day to the 6th day ($p<0.05$) (Fig. 3).

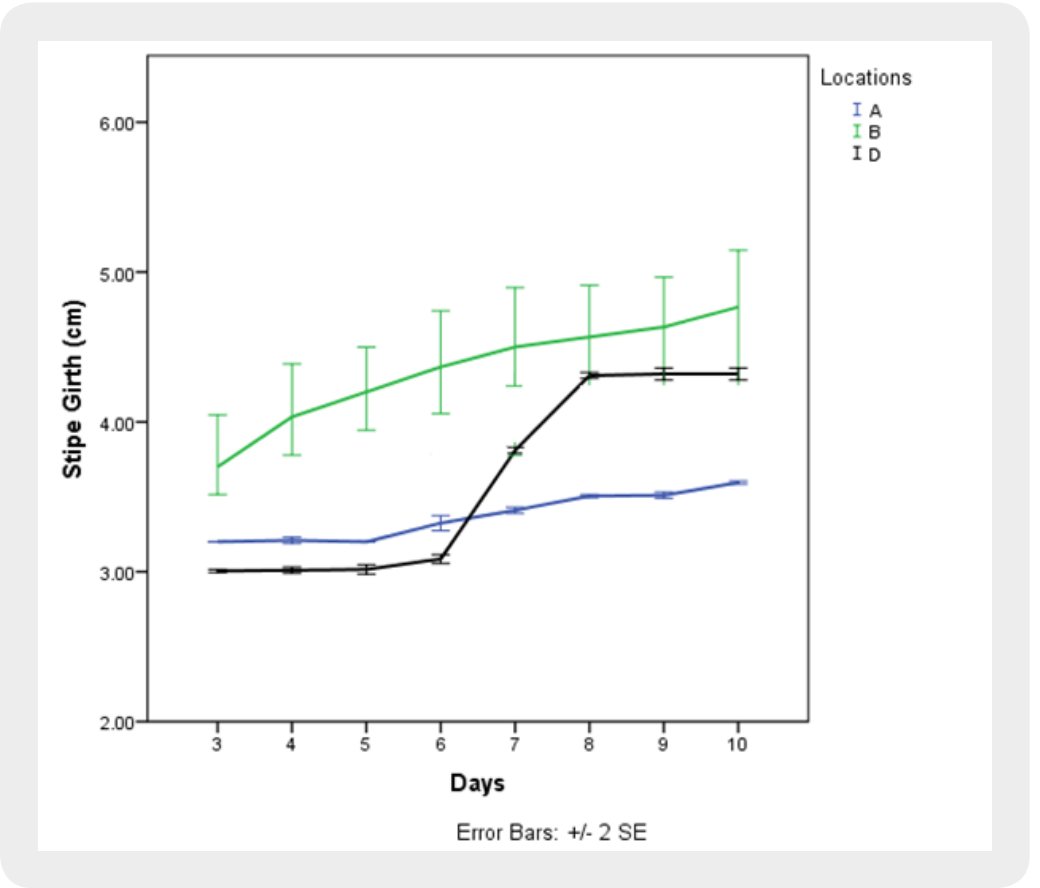

Figure 3: *Stipe Girth of Pleurotus tuber-regium at different locations*

Percentage Occurrence and Abundance of Insects Associated with Pleurotus Tuber-Regium Cultivation: Result of the percentage occurrence of insects associated with *Pleurotus tuber-regium* cultivation revealed that the insect *Scaphisoma* sp. gave highest percentage occurrence in Location A (30.77±0.000%) while Larvae of *Bradysia* sp. gave highest percentage occurrence in Location B (15.38±0.000%). In comparison between locations, the occurrence of insects is higher in Location A (16.92±11.411%) than Location B (3.59±5.715%). There was no significant difference in insect occurrence between location and insect type ($p>0.05$) (Table 2).

Table 2: *Percentage occurrence of insects associated with Pleurotus tuber-regium cultivation*

Location Insect type	A	B	C	D	E
Staphlinus sp.	7.69±7.690	7.69±7.690	0.00	0.00	0.00
Scaphisoma sp.	30.77±0.000	0.00±0.000	0.00	0.00	0.00
Alphitobius sp.	23.08±0.000	2.56±4.440	0.00	0.00	0.00
Bradysia sp. (larvae)	0.00±0.000	15.38±0.000	0.00	0.00	0.00

Larvae of *Alphitobius* sp.	15.38±0.000	0.00±0.000	0.00	0.00	0.00
Total	**16.92±11.411**	**3.59±5.715**	**0.00**	**0.00**	**0.00**

p-value (Location: % Occurrence): 0.002
p-value (Insect type: % Occurrence): 0.217

Result on abundance of insects revealed that Larvae of *Alphitobius* sp. gave highest abundance in Location A (18.00±0.000) while Larvae of *Bradysia* sp. gave highest abundance in Location B (8.33±13.577). In comparison between locations, the abundance of insects is higher in Location A (6.40±6.878) than Location B (3.13±6.968). There was significant difference in insect abundance between locations but no significant difference between insect type ($p>0.05$) (Table 3).

Table 3: *Abundance of insects associated with Pleurotus tuber-regium cultivation*

Location Insect type	A	B	C	D	E
Staphlinus sp.	3.00±0.000	6.33±7.767	0.00	0.00	0.00
Scaphisoma sp.	6.00±0.000	0.00±0.000	0.00	0.00	0.00
Alphitobius sp.	5.00±0.000	1.00±1.732	0.00	0.00	0.00
Bradysia sp. (larvae)	0.00±0.000	8.33±13.577	0.00	0.00	0.00
Larvae of *Alphitobius* sp.	18.00±0.000	0.00±0.000	0.00	0.00	0.00
Total	**6.40±6.878**	**3.13±6.968**	**0.00**	**0.00**	**0.00**

p-value (Location: Abundance): 0.391
p-value (Insect type: Abundance): 0.575

Result on population of insects at harvest revealed that only one type of insect (Larvae of *Alphitobius* sp.) was found in location A while three types of insect (*Staphlinus* sp., *Alphitobius* sp. and Larvae of *Bradysia* sp.) were found in location B. The abundance of insects was highest in location A (Table 4).

Table 4: *Population of insects on Pleurotus tuber-regium at harvest*

Location Insect type	A	B	C	D	E
Staphlinus sp.	0	9	0	0	0
Scaphisoma sp.	0	0	0	0	0
Alphitobius sp.	0	1	0	0	0
Bradysia sp(larvae)	0	2	0	0	0
Larvae of *Alphitobius* sp.	21	0	0	0	0
Total	**21**	**12**	**0**	**0**	**0**

Table 5: *Yield of Pleurotus tuber-regium at harvest*

Location	Stipe girth (cm)	Cap diameter (cm)	Fresh weight (g)	Dry weight (g)
A	3.41±0.014a	4.31±0.021b	6.12±0.028a	1.46±0.359a
B	4.75±0.674b	8.90±1.015c	13.82±0.359b	3.10±0.240c
C	0.00	0.00	0.00	0.00
D	4.32±0.028b	1.23±0.035a	6.69±0.028a	2.00±0.014b
E	0.00	0.00	0.00	0.00
p-value	0.087	0.001	0.000	0.001

Result of yield of *Pleurotus tuber-regium* harvested at 11 days after emergence revealed that *P. tuber-regium* harvested at location B gave highest stipe girth (4.75±0.674cm), cap diameter (8.90±1.015cm), fresh weight (13.82±0.359g) and dry weight (3.10±0.240g) while *P. tuber-regium* harvested in location A gave lowest stipe girth (3.41±0.014cm), fresh weight (6.12±0.028g) and dry weight (1.46±0.359g). There was a significant difference in the cap diameter, fresh weight and dry weight of *Pleurotus tuber-regium* between the three locations at harvest ($p<0.05$) (Table 5).

Discussion

Pleurotus tuber-regium was cultivated in five different locations for production of fruit bodies and monitoring the sporophores at different stages for pest infestation. Only three of the locations produced sporophores. The substrates placed in front of the Botany Laboratory (location C) did not produce because of the presence of green mould (Table 1). This is in line with the work done by Sharma *et al.*, (2007) [12], which showed that presence of green mold hinders production of sporophores. Those grown under direct sunlight (location E) failed to produce sporophore, probably due to the dry weather condition, as they were placed in the open, directly under the sun. This concurs with the findings of Onwubuya *et al.*, (2015) [5] where he reported that lack of water is a constraint to mushroom production. The identified insects include: *Staphylinus* sp, *Alphitobius* sp, *Bradysia* sp (Fungus gnats), and *Scaphisoma* sp., (Table 2). This agrees with previous findings (Ajayi and Jonathan, 2004; Fasidi *et al*, 2008) [13,14] where it was observed that mushroom flies - sciarids, cecids and phorids enter the mushroom house and breed on the substrate during cropping period.

Scaphisoma sp. was the highest occurring insect pest on mushrooms produced under *Citrus* sp. tree (Table 2). This can be as a result of the mushroom growing in the midst of other grasses and plants like *Citrus* sp., *Panicum maximum, Chromolenae odorata* among others. This arthropod might have invaded the mushroom fruit body from the nearby grasses. Larvae of *Bradysia* sp occurred more on sporophores produced inside the laboratory (Table 5). This may be because, the substrate is always wet and the larva lives in such condition as observed by Singh and Sharma, (2016) [15]. The larvae of *Alphitobius* sp. gave highest abundance in mushrooms produced under *Citrus* Sp. tree (Table 3). There number kept multiplying daily as the egg laid by the adult within the gills of the mushroom continues to hatch.

Comparing the two locations that had insect pest infestation (Table 4), it can be said that similar insect pest attack the mushrooms irrespective of the location. However, the abundance and severity of the insect pests is

determined by the mushroom environment (Table 3). At harvest, those grown in the laboratory, gave the highest yield in terms of cap diameter, stipe girth, fresh weight and dry weight while those grown under *Citrus* sp. tree gave the lowest yield in same parameters (Table 5). The high yield from those grown in the laboratory may be because the insect pests gained entry into the mushroom few days to its harvest. Consequently, the mushrooms were not damaged to a great extent by these insect pests. The low yield from mushrooms produced under *Citrus* Sp. tree may be due to the infestation of the larvae of *Alphitobius* sp. which ate the produce sporophores.. They feed, on the fruit bodies, starting from the gills downward to the stipe. These insect pest therefore, might have reduced the yield of mushrooms produced under *Citrus* Sp. tree which concurs with the report of Onwubuya *et al.*, (2015) [5], that pest affect mushroom yield adversely.

At harvest only the Larvae of *Alphitobius* sp. was seen on mushrooms produced under *Citrus* Sp. tree while *Staphlinus* sp., *Alphitobius* sp. and Larvae of *Bradysia* sp were found on the ones cultivated inside the laboratory (Table 5). This is likely because the Larvae of *Alphitobius* sp. found on mushrooms grown under *Citrus* sp. tree is very active and being numerous, they seem to eat everything on their path even as they increase in number. They are seen to dominate the gills and start their activity from there. Some eat upwards to the cap and others eat downward to the stipe. If not for anything, their number and active nature can drive away other insect pest that stands on their way [16].

Conclusion

Sporophores of *Pleurotus tuber-regium* was grown from its sclerotia using soil as substrate. The experiment, carried out in Awka, was targeted at identifying the pests and pathogens of cultivated *P. tuber-regium* in the area. It was observed that most of these insect pests live and breed under the mushroom cap. Only one was seen to live on the substrate. The following insect pests: *Alphitobius* sp. and its larvae; larvae of *Bradysia* sp; *Staphlinus* sp. and *Scaphisoma* sp. were seen to be associated with the cultivation of *Pleurotus tuber-regium* in Awka Anambra State. All of them devalue the mushroom in one way or the other. However, the larvae of *Alphitobius* sp. was more abundant on those cultivated under the *Citrus* sp. while *Staphlinus* sp. was more abundant on those grown inside the laboratory. Also, *Alphitobius* sp. and its larvae caused the most significant damage to the mushroom body. Meanwhile, the occurrence, abundance, severity and activity of these mushroom insect pests are dependent on the environment of the mushroom.

It is recommended that strategies should be put in place to combat these pests, especially *Alphitobius* sp. and its larvae. Fruit bodies should be harvested before development of cap or when the primodia is 4 days old. Secondly, to avoid losing the whole crop (matured mushroom), once *Alphitobius* sp. is seen moving on or around the mushroom fruit-body, then harvest at most the next two to three days (5 to 6 days after emergence). Moreover, cultivation can also be done strictly in an enclosure / cupboard.

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