There were significant difference (P<0.05) between control T_1 (topsoil only), which gave the highest pileus diameter of 16.05 cm and T_6 (1:4) which gave a pileus diameter of 7.37cm while T_6 (1:4) with a pileus diameter of 7.37 differed significantly (P<0.05) from T_5 (2.3) and T_7 (1:1) with the pileus diameter of 0.56cm and 0.75cm respectively.

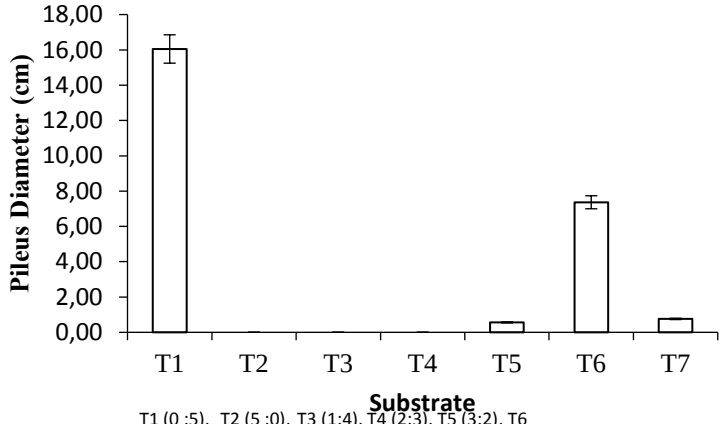

Fig. 1: Effect of Treatments on Pileus Diameter (cm) of *P. tuberregium*

Effect of treatments on Stipe Height (cm) of *P. tuberregium.*

The highest stipe height was given by control T_1 (topsoil only) - 8.38 cm which differed significantly (P<0.05) from T_6 (1:4) of a stipe height of 5.22 cm (Fig. 2). The lowest heights were given by T_5 (2:3) 1.16 cm and T_7 (1:1) giving 1.72 cm. There were significant differences (P<0.05) between T_6 (1:4) which gave 5.22 cm and T_5 (2:3) and T_7 (1:1) which gave 1.16 cm and 1.72 cm respectively. No growth was observed in control T_2 (decomposed palm bunch only), and T_3 (4:1) and T_4 (3:2).

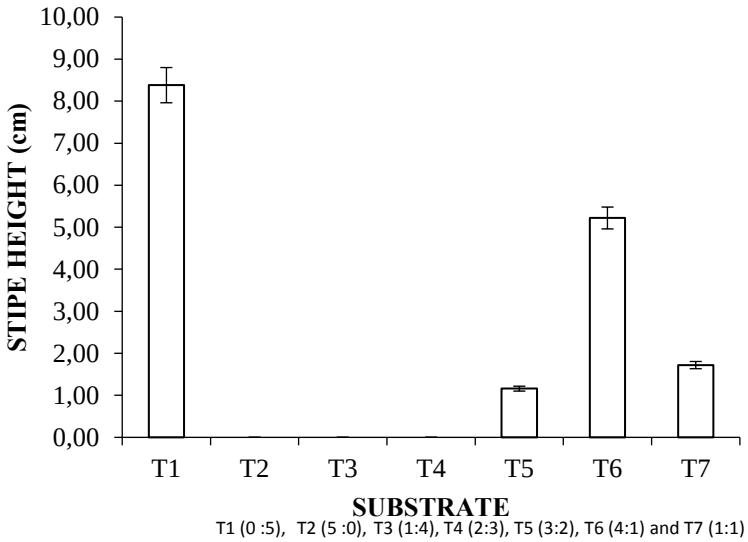

Fig. 2: Effect of Treatments on Stipe Height (cm) of *P. tuberregium*

Effect of treatments on Stipe Girth of *Pleurotus tuberregium*

There was no significant difference ($P<0.05$) between control T_1 (topsoil only) which gave a stipe girth of 4.98 cm and T_6 (1:4) with a stipe girth of 4.02 cm (Fig. 3). However, both control T_1 (topsoil) with value of 4.98 cm and T_6 (1:4) with value of 4.02 cm in stipe girth differ significantly ($P<0.05$) from T_5 (3:2) with stipe girth of 0.78 cm and T_7(1:1) with stipe girth of 1.91 cm. From the result shown T_5 (3:2) and T_7 (1:1) did not differ from one another.

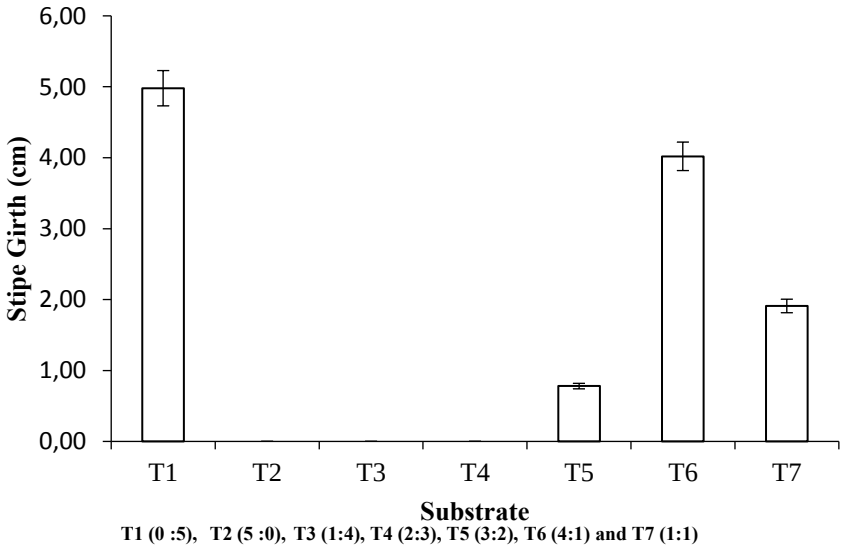

Fig. 3: Effect of Treatments on Stipe Girth (cm) of *P. tuberregium*

Effect of treatments on the yield of *Pleurotus tuberregium*

The effect of the various mixtures of decomposed palm bunch refuse and topsoil on the yield of *P. tuberregium* is as shown on Fig. 3. Results show that the control T_1 (topsoil) gave the highest wet and dry weight of 356.87g and 62.37g followed by T_6 (1:4) which recorded a wet and dry weight of 191.95g and 31.43g respectively. From the result control T_1 (topsoil only) was significantly higher than T_6 (1:4). The lowest value were recorded by T_7 (1:1) which gave a wet and dry weight of 1.32 and 0.32g, and T_5 (3.2) with a wet and dry weight of 2.64g and 0.45g. Nevertheless, T_1 (topsoil only) gave the highest yield.

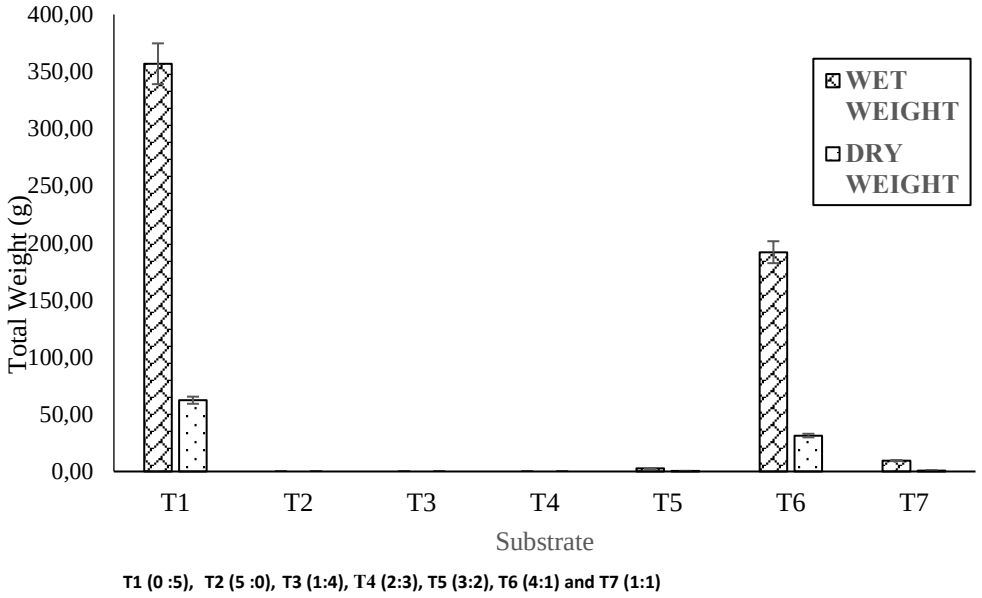

Fig. 4: Effect of Treatment on Wet and Dry Yield (g) of *P. tuberregium*

The Proximate Analysis of Harvested Mushroom

From the result shown in Table 1 the moisture content of control T_1 (topsoil only) did not differ significantly from that of T_6 (1:4). The highest percentage Ash was recorded in T_6 (1:4) while control T_1 (topsoil only) gave the lowest percentage of 2.09%. Ether Extract (fat/oil) was 2.9% in control T_1 (topsoil) while T_6 (1:4) recorded 1.43%, they were not significantly different from one another. There was no significant difference in percentage crude protein recorded between T_6 (1:4) which was 20.06% and that of control T_1 (topsoil only), 18.28%. Control T_1 (topsoil only) recorded percentage crude fibre of 58.49 while T_6 (1:4) gave percentage crude fibre of 49.73. T_6 (1:4) recorded a higher carbohydrate percentage of 11.74 while control T_1 (topsoil only) gave 9.23% carbohydrate.

Proximate composition of mushroom harvested from T_5 and T_7 were significantly low as compared to T_1 and T_6.

Table 1: Effect of the Various Ratios on Proximate Analysis of Harvested Mushroom

Substrates	Moisture Content (%)	Ash (%)	Ether Extract (%)	Crude Protein (%)	Crude Fibre (%)	Carbohydrate (%)
T_1 0:5 (Control)	8.66	2.09	2.09	18.28	58.49	9.23
T_2 5:0 (Control 2)	0	0	0	0	0	0
T_3 (4:1)	0	0	0	0	0	0
T_4 (3:2)	0	0	0	0	0	0
T_5 (2:3)	1.23	0.78	0.02	1.28	2.04	1.20
T_6 (1:4)	8.75	8.28	1.43	20.06	49.73	11.74
T_7 (1:1)	2.07	1.07	0.79	5.10	5.30	2.90
LSD P<P0.05	3.92	2.86	ns	Ns	1.26	1.31

T1 (0 :5)-Topsoil (TS), T2 (5 :0)-Decomposed palm bunch refuse (DPBR) (Control T2), T3 (1:4)-1 part DPBR + 4 part TS, T4 (2:3)-2 part DPBR + 3 part TS, T5 (3:2)-3 part DPBR + 2 part TS, T6 (4:1)-4 part DPBR + 1 part TS, T7 (1:1)-Equal part DPBR + Equal part TS

Mineral Content of *Pleurotus tuberregium*

T_1 (topsoil only) having the highest sodium (Na) value of 743.00 cmol/kg while T_6 (1:4) gave 319.10 cmol/kg. T_6 (1:4) recorded the highest potassium (k) value of 1074.12 cmol/kg while control T_1 (topsoil only) gave the highest calcium (ca) value of 2392.75 cmol/kg while T_6 (1:4) recorded calcium (ca) value of 223.73 cmol/kg. T_1 (topsoil only) recorded the highest phosphorous (p) value of 510.33 cmol/kg while T_6 (1:4) recorded phosphorous (p) value of 107.51 cmol/kg. While control T_1 (topsoil only) gave iron (Fe) content of 260.88 cmol/kg, T_6 (1:4) recorded iron value of 137.57 cmol/kg. Chromium (Cr) content found in control T_1 (topsoil only) is 1.88 cmol/kg while T_6 (1:4) had a significantly low value of <0.01. Control T_1 (topsoil only) gave zinc (Zn) content of 68.38 cmol/kg while T_6 (1:4) recorded zinc content of 26.39 cmol/kg mushroom harvested from T_5 and T_7 recorded low value in mineral content.

Table 2: Mineral Content of Harvested *Pleurotus tuberregium*

Trt	Na (cmol/kg)	K (cmol/kg)	Ca (cmol/kg)	P (cmol/kg)	Mg (cmol/kg)	Fe (cmol/kg)	Cr (cmol/kg)	Zn (cmol/kg)
T_1	743.00	240.38	2392.75	510.33	295.63	260.88	1.88	68.38
T_2	0	0	0	0	0	0	0	0
T_3	0	0	0	0	0	0	0	0
T_4	0	0	0	0	0	0	0	0
T_5	0.50	10.36	20.60	0.86	0.75	0.26	0.00	0.05
T_6	319.10	1074.12	223.73	107.51	94.35	137.57	<0.01	26.39
T_7	80.70	38.56	78.01	0.90	0.60	0.38	0.00	1.08

T1 (0 :5)-Topsoil (TS), T2 (5 :0)-Decomposed palm bunch refuse (DPBR) (Control T2), T3 (1:4)-1 part DPBR + 4 part TS, T4 (2:3)-2 part DPBR + 3 part TS, T5 (3:2)-3 part DPBR + 2 part TS, T6 (4:1)-4 part DPBR + 1 part TS, T7 (1:1)-Equal part DPBR + Equal part TS

Nutrient Composition and Particle Size of Substrates Used in Growing *Pleurotus tuberregium*

Table 4.4 shows the nutrient composition and particle size of substrates used in growing *Pleurotus tuberregium*. The result of the nutrient composition and particle sizes of all the treatment used to grow *Pleurotus tuberregium* reveals that all the treatments are alkaline in nature with pH

value ranging from 8.5-9.6. The highest organic carbon was recorded in control T_1 (topsoil only) and the least was by control T_2 (decomposed palm bunch only) which gave 1.11%. Nitrogen content of other substrates was same range of 0.02-0.04. The highest phosphorous (p) of 842.11 cmol/kg was recorded in T_4 (3:2) while the lowest of 29.74 cmol/kg was recorded in control T_1 (topsoil only). The highest potassium (k) value of 1400.00 cmol/kg was recorded in T_6 (1:4) while the lowest potassium (k) value of 29.74 was recorded in control T_1 (topsoil only). Control T_2 (decomposed palm bunch refuse only) was highest in sodium (Na) 11.30 cmol/kg while the lowest was 0.33 cmol/kg in control T_1 (topsoil only).

Calcium (ca) content of T_3 (4:1), T_4 (3:2), T_5 (2:3) were 13.40 cmol/kg, 13.60 cmol/kg, and 13.60 cmol/kg respectively while T_7 (1:1) recorded 12.60 cmol/kg. Control T_1 (topsoil only) and T_6 (1:4) recorded calcium value of 9.60 cmol/kg and 9.20 cmol/kg respectively. Control T_2 (decomposed palm bunch refuse only) recorded 7.40 cmol/kg. For magnesium, T_6 (1:4) gave the highest magnesium (mg) value of 9.40 cmol/kg while the lowest is control T_1 (topsoil only) 0.40 cmol/kg.

Particle size analysis as shown in Table 4.4 indicates that the textural class of control T_1 (topsoil only) to be sandy loam, control T_2 (decomposed palm bunch only) is sandy clay loam, T_3 (4:1) is sandy clay loam, T_4 (3:2) is sandy clay loam, T_5 (2:3) is sandy clay loam, T_6 (1:4) is sandy loam while T_7 (1:1) is sandy clay loam.

Table 3: Nutrient Content and Particle Sizes of Substrate used in cultivation of *Pleurotus tuberregium*

S/N	Parameters	T_1	T_2	T_3	T_4	T_5	T_6	T_7
1.	Sand (%)	80.00	58.00	62.00	68.00	72.00	78.00	72.00
2.	Silt (%)	3.40	7.40	9.40	5.40	5.40	3.40	7.40
3.	Clay (%)	16.60	34.60	28.60	26.60	22.60	18.60	20.60
4.	Textural Class	Sandy loam	Sandy clay loam	Sandy clay loam	Sandy clay loam	Sandy clay loam	Sandy loam	Sandy clay loam
5.	Soilp H_w(l:2.5)	8.50	9.60	9.60	9.60	9.50	9.30	9.40
6.	Organic Carbon (%)	2.44	1.11	1.58	1.83	1.79	2.36	2.30
7.	Total Nitrogen (%)	0.02	0.04	0.04	0.02	0.02	0.04	0.02
8.	P (cmol/kg)	82.46	701.75	196.49	842.11	526.32	456.14	210.53
9.	K (cmol/kg)	29.74	323.08	230.77	174.36	35.90	1400.00	117.95
10.	Na (cmol/kg)	0.33	11.30	7.83	5.57	5.04	2.09	4.52
11.	Ca (cmol/kg)	9.60	7.40	13.40	13.60	13.40	9.20	12.60
12.	Mg (cmol/kg)	0.40	3.80	0.60	0.60	3.00	9.40	2.00

T1 (0 :5)-Topsoil (TS), T2 (5 :0)-Decomposed palm bunch refuse (DPBR) (Control T2), T3 (1:4)-1 part DPBR + 4 part TS, T4 (2:3)-2 part DPBR + 3 part TS, T5 (3:2)-3 part DPBR + 2 part TS, T6 (4:1)-4 part DPBR + 1 part TS, T7 (1:1)-Equal part DPBR + Equal part TS

4. Discussion

There were significant differences in the pileus diameter, stipe girth and stipe height of the mushroom harvested from the different substrates. This may be due to the low sodium content found in control T_1 (topsoil). The low amount of sodium may have been insignificant to interfere with the availability and absorption of essential growth nutrients such as phosphorous, potassium etc. needed by *P. tuberregium* for growth. Although control T_1 (topsoil) has the lowest nutrient as shown in table (1) yet it performed better than T_6 (1:4) with the highest amount of nutrient. This confirms the finding of Brady (1999) that

the presence of sodium carbonate in soil raises soil pH, rendering nutrients like phosphorous, manganese, and zinc unavailable for plant growth. Based on Brady (1999) findings, substrates with high sodium content and higher nutrient content could not perform better because these nutrients were not made available to be absorbed by the sclerotia and therefore affect the required growth needed.

Effect of the Various Mixtures on the Dry and Wet Yield of the Mushroom

The study shows the mean wet and dry yield of mushroom harvested from each of the substrates used in this experiment. Control T_1 (topsoil) gave the highest wet and dry weight of 356.87g and 62.37g respectively followed by T_6 (1:4) which gave wet and dry weight of 191.95g and 31.43g respectively. T_5 (2:3) gave the lowest wet and dry wet of 2.64g and 0.45g. The higher yield of T_1 (topsoil) may be due to the fact that it also recorded the highest cap diameter and stipe height as there seems to be a direct relationship between stipe height, pileus diameter, stipe girth and total yield of mushroom. This observation agrees with the report of Ha Hi Hoa *et al.* (2015) that mushroom weight is influenced by the cap diameter, length and thickness of stipe and the number of effective fruiting bodies and the thickness of the cap.

Proximate Composition of Harvested Mushroom

The comparative proximate composition of *P. tuberregium* harvested from substrate T_1 (topsoil), T_5 (3:2), T_6 (1:4) and T_7 (1:1) as shown in Table (4). The moisture content of mushroom harvested from Control T_1 (topsoil) and T_6 (1:4) showed no significant difference $P<0.05$. It could therefore be assumed that both substrates have same water holding capacity. The difference in values between the proximate composition of control T_1 (topsoil), T_5 (3:2), T_6 (1:4) and T_7 (1:1) may be due to difference in the nutritional composition of each of these substrates which may have contributed immensely in the nutritional composition of the mushroom. These results are in agreement with the report of Jawad *et al.* (2013), who worked on the effect of substrate supplement on oyster mushroom production. Beluham and Ranogajee (2001) also reported that mushroom is potential source of total carbohydrate in the range of 42.62 – 66.78g/100g, very low fat content 1.34 – 6.45g/100g and also rich in protein 27.95 – 38.99g/100g depending on the type of specie. Oyster mushroom is rich in fiber and low in fat content and this character is highly beneficial for heart patients, (Jawal *et al.*, 2013).

Mineral Content of Harvested *Pleurotus tuberregium*

Result shows that Control T_1 (topsoil) produced mushroom with higher mineral content than T_6, while low mineral content were recorded in T_5 and T_7. This high mineral content of T_1 may be due to its low sodium content resulting to higher available nutrient in the substrate. The inherent nutrient in sclerotia were utilised effectively for primordial stage and formation of fruiting body with high nutrient value. These minerals found in oyster mushroom can help in supplying nutrient to the body. The high concentration of these minerals is advantageous since certain inorganic mineral elements such as potassium, zinc, calcium, and magnesium play important roles in the maintenance of normal glucose

tolerance and in release of insulin from beta cells of islets of Langerhans (Kar *et al.*, 1999, Agomuo, 2011).

5. Conclusion

The result in this study has revealed that decomposed palm bunch refuse and topsoil can be mixed into the right ratio for the cultivation of *Pleurotus tuberregium.* One part decomposed palm bunch refuse and 4 parts topsoil by weight appears to be the best mixture for increased production of *Pleurotus tuberregium*.

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