EFFECTS OF DIFFERENT ORGANIC MULCH MATERIALS ON THE PERFORMANCE AND FUNGAL DISEASES OF PEPPER (*Capsicum annum* L) IN OWERRI, NIGERIA.

NWOKEJI, E.M., NWUFO, M.I., AGU, C.M., IHEJIRIKA, G.O., PETER-ONOH, C., OGWUDIRE, V.E. OKERE, S.E. EMMANUEL- OKAFOR, L C., COOKY, C.O. AND KEYAGHA, E. R.
Department of Crop Science and Technology, School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri.
Email: ephraimmaduako@yahoo.com

ABSTRACT
A field experiment was conducted at the Teaching and Research Farm of the School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, Imo State, Nigeria. The experiment was laid out in Randomized Complete Block Design (RCBD) and replicated five (5) times. The treatments used included dry palm bunch, wood shavings, pasphalum grass mulch and the control (no mulch). Data were collected on growth and yield parameters and statistically analyzed, using analysis of variance (ANOVA) while the means were separated for difference using the least significant difference at 5% level of probability (P=0. 05). Results indicated that different mulch materials had variable effects at 5% level of significance on the growth and yield parameters and on the disease incidence. Dry palm mulch gave the highest pepper yield of 3.82kg\ha, and wood shavings had the lowest fungal disease infection.
Key Words: organic mulch, fungal diseases performance, pepper.

INTRODUCTION

Pepper (Capsicum species) is a member of the Nightshade family or Solanaceae. Peppers are thought to have been introduced into Nigeria from the New World (AVRDC, 1989). Two main species, *C. annum L.* and *C. frutescens* (sweet pepper and hot or chili pepper), respectively, have been identified to be widely grown (AVRDC, 1989). However, Uguru (1996) included two other cultivated species namely:*Capsicum pubescens*, which includes the South American rocoto peppers and *Capsicum baccatum*, which includes the South American aji peppers.

In Nigeria, sweet pepper is cultivated outdoors as either rain-fed or irrigated crop mainly in the northern states (Olaruwaju, 1980), where production has been mainly limited to peasant farmers (Abulmalik *et al, 2012*). The large scale production of pepper in the Tropics has been limited due to lack of flower buds and young fruits in both temperate and tropical regions of the world (AVRDC, 1989). This disorder is most often associated with large fruited sweet pepper such as the bell types (Sawahata, 1980). Pepper needs soils that have been ploughed to a depth of 25-30cm (Amati *et al,1989*).

Pepper is among the widely grown and consumed vegetable world-wide .Abdulmalik *et al* (2012) observed that pepper is the second most important crop among the Solanaceous fruits. They went further to state that pepper is by far superior to tomato and eggplant in vitamins A and C content. Pepper also contains significant quantities of protein and minerals (Yamguchi, 1983). AVRDC (1989) noted that Nigeria is the largest producer of pepper in African, accounting for about 50 % of the African production. Consumption of pepper accounts for about 20% of average vegetable consumption per person per day (AVRDC, 1989). It is used as a spice in various food preparations including, stews and soups, and also in medicinal preparation and coloring (AVRCD, 1989). Pepper oil is valued as flavouring for sausages, canned meat and liquors. Pepper has been reported in folk medicine for curing dropsy, colic, toothache, cholera, headache, rheumatism; and its extracted compound (capsaicin) is used for treating sprains and bruises (Pierre, 1987).

Wisdom and Akpan (1983) defined and outlined the role of mulching in relation to crop husbandry and disease management: application of a covering layer of materials to the soil surface to modify soil physical properties, create favourable environment for root development and nutrient uptake and reduce soil erosion and degradation. Hoitink and Fahy (1986), noted that pathogens are killed by the heat generated in the production of compost. Valverde and Bandy (1982), specified the reduction of soil temperatures, which have significant effects on the ability of soil-borne plant pathogens to cause diseases. Reduction of soil splashing is an important function of mulches in the management of some plant pathogens (Fitts and Mclartney,1986; Moreno and Mora, 1984). They also identified rain splash as the second most important natural agent, after wind, in the dispersal of spores of plant pathogenic fungi. Moisture is preserved during dry periods by mulches, so they help to provide a constant water supply to plants, in this case mulches can reduce the incidence of wilt infections.

Agricultural production requires sufficient allocation of fund; but this has not been so in the country (Nigeria). In the recent time (2022), agriculture was allocated only 1.8% of the total annual budget by the Federal Government (Izuaka, 2022). This allocation is grossly inadequate to address the catalogue of

challenges militating against agricultural development in the country.

This ugly trend requires the exploration of cheap means of producing useful crops with the available fund. This, therefore, justifies the use of organic mulches in this work. This is corroborated by the foregoing emphasis on the advantages of mulching in the control of plant pathogens. This work, therefore, aims to address the effects of organic mulch materials on the growth, yield and fungal diseases of the pepper plant.

MATERIALS AND METHODS

Description of Experimental Site

The experiment was conducted at the Teaching and Research Farm, and in the Crop Science and Technology Laboratory of the School of Agriculture and Agricultural Technology, Federal University of Technology, Owerri, Imo State, Nigeria, in the year, 2011. The location is situated at 5.4891^0N and $7^0.025853$"E. The soil of the area is characterized by deep, porous, red soil, highly weathered and low in mineral reserves (Ononiwu, 1990). The area has a minimum and maximum temperature ranges of 20 ^oC and 32 ^oC respectively, with a mean annual rainfall of about 2,500mm, which spans a period from early March to October, with a dry spell (August Break), and relative humidity of between 38% and 99% annually (Nwosu and Adeniyi, 1980).

The Materials Used: The materials used consisted mainly of seeds of large red pepper and different organic mulch materials, which included dry pasphalum grass mulch, dry palm bunch and wood shavings. Wood shavings, dry palm bunch and grass mulch were obtained from Njoku Saw Mill, Owerri, David Oil mill, Umuchima (Ihiagwa), and the environs of the Federal University of Technology, Owerri, respectively.

Nursery Establishment and Site Preparation:The pepper cultivar for the research was raised in wooden containers in a screening house. Sterilized top soil, cured poultry droppings and sharp sand were mixed in the ratio of 3:2:1. The wooden containers were filled with the mixture. Watering, weed and pest control were carried out manually.

The experimental site measured $145.2m^2$($0.015ha^2$) and was cleared of bushes and trash removed. The area was mapped out into five blocks; each block contained four (4) plots. The block size was 1.8 x 2.4m. The space between plots and blocks was 0.5m. Beds (plots) were made manually through the use of spades.

Experimental Design, Seedling Transplanting and Treatments Application: The treatments consisted of wood shavings, dry palm bunch, dry grass mulch, and no mulch (the control). The treatments were laid out in Randomized Complete Block Design (RCBD), with five replications. The seedlings were transplanted eight (8) weeks after sowing in the nursery. The seedlings were spaced 60 x 60cm. A total of 240 stands of pepper plants were obtained as the plant population. Each block contained 48 seedlings, while a plot contained a total of 12 seedlings. The treatments (organic much materials) were spread uniformly on the plots one week after transplanting the seedlings.

Field Maintenance: Adequate field maintenance was done. Weeding was done three times, at the 3rd, 6th and 9th week after transplanting using hoe. Insect pests were checked by the use of neem (*Azadirachta indica*) extract.

Growth and Yield Parameters Measured

(a) **Plant height:** This was obtained by measuring the height of the plant from the base to the apex of the leaf with a meter rule in centimeter (cm).The measurement was taken at 3rd, 6th, 9th and 12th weeks after transplanting.

(b) **Number of leaves:** This was obtained by counting the number of fully opened leaves per plot at 3th, 6th, 9th and 12th week after transplanting.

(c) **Leaf area:** This was obtained by measuring the length of the midrib and the widest width (and they were multiplied). Leaf area was calculated by the formula proposed by Asoegu (1998). The leaf area was taken at 3th and 12th week after transplanting.

(d) **Fresh fruit weight:** Fruits were harvested and weighed per treatment and average /mean taken.

(e) Disease assessment (incidence and severity):

i. Disease incidence (DI) $= \frac{\text{Number of Diseased Plants per Plot}}{\text{Total Number of Plants in the Plot}} \text{x} \frac{100}{1}$

ii. Disease severity (DS) was assessed by the use of the following scale:

Severity (%)	Scale	Interpretation
0	0	No infection
1-20	1	Slight infection
21-40	2	Moderate infection
41-60	3	Extensive infection
61-80	4	Very extensive infection
81- 100	5	Completely-infected

(Coggan *et al*,.1997)

(f) **Preparation of Potato Dextrose agar medium:** Potato dextrose agar (PDA) medium was prepared by weighing out 250g of Irish potato tubers. The tubers were peeled, diced, washed and boiled in 500ml beaker in a sterilized chamber. The supernatant liquid was filtered out through cheese cloth into a one-liter capacity conical flask and made up

to 1liter with sterile distilled water. Twenty (20)g of agar powder and twenty(20)g of dextrose were added to the broth, and heated on a hot plate in order to melt the substances and homogenize the whole substances (Ofoh,2005). The one-liter conical flash was plugged with cotton wool and then covered with aluminum foil for sterilization. Sterilization was done in an autoclave at 1.50kgcm^{-2} at 120^{0}C for 30minutes. The PDA medium was dispensed in Petri-dishes after autoclaving and allowed to set, subsequent to isolation procedures.

(g) **Isolation of the fungus (*Fusarium oxysporum*) from infected plant parts (leaves and stems):**

Infected pepper plant parts were obtained during the vegetative and reproductive stages of the fungus, when only the pathogen responsible for the infection was present (Mehrotra and Aggrawal, 2006) and taken to the laboratory. Surface disinfection as prerequisite for a successful isolation was done by repeated washing under running water, and later in distilled water. The samples were further surface-sterilized with 70% alcohol and rinsed in several changes of distilled water. Tissues of the samples, with distinct lesions were lifted with flamed forceps and plated onto hardened PDA medium in six Petri-dishes, and each sample well labeled for proper identification. The dishes were incubated and observation was made after seven (7) days for fungal growth and sporulation. The predominating fungi were later re-isolated unto fresh PDA for growth in pure cultures. Fungi were identified by means of a compound microscope on the basis of spore morphology, colour of mycelium and nature of hyphae as described by Scagel*et al, (1984*) and Barnett (1998). The pathogens identified were *Fusarium oxysporum* and Cercospora species.

RESULTS AND DISCUSSION

Table 1 shows no significant (P>0.05) difference at 3rd week and 6th week after transplanting, while in 9th week and 12th week there was significant (P<0.05) difference in the highest plant height. Dry palm bunch gave the highest plant height (19.13cm), while wood shavings gave the lowest plant height at 12th week after transplanting. This agrees with Hugh (2011), who explained that wood shavings were better suited for mulching trees and shrubs, because they break down slowly to become incorporated into the soil. This means that the pepper plant would have attained significant height if it were a tree or shrub when the wood shavings would have been broken down and become incorporated in the soil to release the nutrients in them. Pure wood materials, like sawdust and wood shavings are very high in carbon and this carbon will absorb all of the plant-feeding nitrogen in the soil in the process of decomposition (Olufolaji, 2017).

Table 1: Effect of Organic Mulch on Pepper Plant Height (cm).

TREATMENT	3WAT	6WAT	9WAT	12WAT
Dry Palm Bunch	12.15	15.35	14.4	19.13
Wood Shavings	15.22	16.89	15.87	17.83
Grass Mulch	18.86	17.45	17.99	18.24
Control (Zero Mulch)	10.89	19.04	18.51	19.04
LSD (0.05)	**NS**	**NS**	**2.60**	**4.47**

In Table 2 statistical result indicated absence of significant (P>0.05) difference among the treatment means. Expectedly, the number of leaves increased progressively from 3rd to 12thweek after transplanting. The control treatment recorded the highest number of leaves (49.67), while the lowest was recorded by wood shavings (3.87) at 3rd week after transplanting.

Table 2: Effect of Organic Mulch on the Mean Number of Pepper Leaves.

TREATMENT	3WAT	6WAT	9WAT	12WAT
Dry Palm Bunch	4.27	10.67	20.67	40.46
Wood Shavings	3.87	9.33	16.87	33.86
Grass Mulch	4.06	6.87	21.27	36.13
Control (Zero Mulch)	4.66	12.47	32.33	49.67
LSD (0.05)	**NS**	**NS**	**NS**	**NS**

In Table 3, leaf area was taken at 3rd and 12th week after transplanting. The result showed no significant (P>0.05) difference among the treatments at 3rd and 12th week after transplanting. The dry palm bunch hard the highest mean leaf area at 3rd week after transplanting (12.76cm^2) and 12th week after transplanting (21.33cm^2), respectively. The wood shavings had the lowest leaf area (13.8cm^2) at 12th week after transplanting. Wood much is high in carbon and it seeks out nitrogen for its breakdown in

the soil, this, therefore hard a negative effect on leaf development (www.hybridveggies.com, 2017). The increased leaf area has a direct positive effect on the yield of pepper. The photosynthetic efficiency in a crop is closely related to the efficiency of the leaf area spread as a result of maximum light interception.

Table 3: Effect of Organic Mulch on Leaf Area (cm^2) of Pepper.

TREATMENT	3WAT	12WAT
Dry Palm Bunch	12.76	21.33
Wood Shavings	8.02	13.84
Grass Mulch	7.99	18.79
Control (Zero Mulch)	11.61	14.11
LSD (0.05)	**NS**	**NS**

The result in table 4 showed no significant (P>0.05) difference for fresh fruit weight. However, dry palm bunch produced slightly higher fruit weight than the rest of the treatments. The absence of significant (P>0.05) difference could be attributed to slow growth of pepper due to other factors. Such factors might include poor soils, as the soils of the experimental area are characteristically ultisols, highly weathered, leached and acidic (Loso,2008; Ononiwu,1990).

Table 4: Effect of Organic Mulches on the Mean Fresh Fruit Weight (kg/plot) of Pepper Plant.

TREATMENT	Fresh Fruit Weight (kg/plot)
Dry Palm Bunch	3.82
Wood Shavings	3.66
Grass Mulch	1.63
Control (Zero Mulch)	3.81
LSD (0.05)	**NS**

The Table 5 shows the result of the effect of organic mulch on the mean fungal disease incidence on pepper at 2^{nd}, 4^{th}, 6^{th}, 8^{th}, 10^{th} and 12^{th} week after transplanting, There was no significant(P>0.05) difference at 2^{nd} , 6^{th} , 8^{th}, $10^{th}$and 12^{th} week after transplanting, while significant (P<0.05) difference was observed at the 4^{th} week after transplanting. The mean wilt disease incidence was the highest under the dry palm bunch (20%) at 4^{th} week after transplanting when compared with other treatments; while wood shavings had the lowest mean disease incidence of 1.81% at the 4^{th} week after transplanting. The mean disease incidence was relatively low under wood shavings across the weeks compared with other treatments. Fitt and McCartney (1986), stated the important function of mulches in the management of some plant pathogens by preventing soil splashing. Wood shavings persist in the soil for reasonable period of time (www.hybridveggies, 2007). In this way, weeds are suppressed and splashing of soil also reduced. This has direct negative effect on soil pathogens.

Table 5: Effect of Organic Mulches on the Mean Fungal Disease Incidence of Tomato (%)

TREATMENT	2WAT	4WAT	6WAT	8WAT	10WAT	12WAT
Dry Palm Bunch	6.67	20.00	11.26	15.00	2.20	4.44
Wood Shavings	5.00	1.81	5.00	0.00	5.00	2.86
Grass Mulch	11.67	13.29	8.79	4.86	2.00	0.00
Control (Zero Mulch)	1.67	16.94	19.05	3.33	0.00	3.33

CONCLUSION

The results of the experiment indicated variable effects of the treatments (dry palm bunch, wood shavings, grass mulch, the control) on the growth and yield parameters and fungal disease of pepper. Dry palm bunch gave the highest pepper yield (3.82/ha), while wood shavings had the lowest fungal disease incidence.

More research attention should be channeled to the broader role of wood shavings in the management of fungal disease pathogens especially *Fusarium oxysporum*.

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